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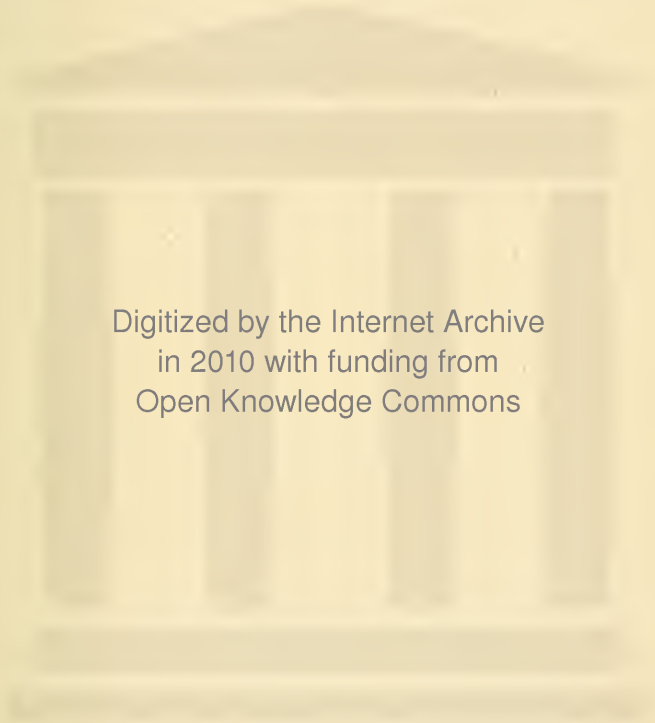
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Tuberculosis of the Testicle

With Special Consideration of
Its Conservative Treatment.

JOHN B. MURPHY, M.D.
Chicago

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TUBERCULOSIS OF THE TESTICLE.

WITH SPECIAL CONSIDERATION OF ITS CONSERVATIVE TREATMENT.

JOHN B. MURPHY, M.D.
CHICAGO.

Before entering into our subject, let us briefly review the anatomy and physiology of the testicle, that we may better understand the pathologic changes and processes of repair which take place when it is the seat of tubercular infection.

The testes are suspended in the scrotum by the two spermatic cords, the left being slightly lower than the right. Each is oval in form, compressed laterally, and occupies an oblique position in the scrotum, the upper extremity being directed forward and outward, and the lower downward and a little inward. The surface of the gland, excepting its posterior border, is free, smooth and covered by the visceral layer of the tunica vaginalis. Lying along the posterior border is a narrow flattened body, the epididymis, which consists of three parts, namely, first, the upper enlarged extremity, globus major; second, the pointed lower extremity, globus minor, and, third, the intermediate portion, or body of the epididymis. The globus major is intimately connected with the upper end of the testicle proper by means of its efferent ducts, while the globus minor is attached to its lower end by cellular tissue and a reflection of the tunica vaginalis. This membrane, the tunica vaginalis, as it leaves the testicle proper at its posterior border, is reflected on to the epididymis, covering its outer surface and upper and lower extremities and completely investing the body, excepting along its posterior border, from which it is again reflected on to the inner

surface of the scrotum. It will thus be seen that a sort of mesentery is formed by the membrane between the testicle proper and the epididymis. Attached to the upper end of the testicle or epididymis are one or more small pedunculated bodies, the most constant of which is called the "hydatid of Morgagni."

Besides the tunica vaginalis, which is the most external, the testis is invested by two tunics, the tunica albuginea and the tunica vasculosa. The tunica albuginea is beneath the serous coat and surrounds the glandular structure of the testis. It is thick and dense, and composed of white fibrous tissue. At the posterior border of the gland it is reflected into the interior, forming an incomplete vertical septum, the mediastinum testis, or corpus Highmorianum, from the edge and lateral surfaces of which numerous fibrous trabeculæ pass, to be attached to the inner surface of the tunica albuginea. These trabeculæ divide the interior of the gland into a number of cone-shaped spaces, the bases of the cones being at the periphery and the apices at the mediastinum. The tunica vasculosa consists of a plexus of blood-vessels, which line the inner surface of the tunica albuginea and the fibrous trabeculæ.

The glandular structure of the testis (Fig. A) consists of numerous cone-shaped lobules (lobuli testis), each contained in one of the spaces described above and composed of one or more convoluted tubules, 2¼ feet in length and 1/150 inch in diameter, the convolutions being held together by an intertubular connective tissue. The connective tissue presents large interstitial spaces lined with endothelium, the rootlets of the lymphatic vessels, and masses of large cells—the interstitial cells—accompanying the finer blood-vessels.

Each seminiferous tubule consists of: 1, a hyaline membrana propria; 2, several layers of epithelial cells—the seminal cells—which are usually arranged as follows: *a*, an outer (deeper) layer of polyhedral cells, the spermatogoma; *b*, an intermediate layer, the cells of which are in active proliferation, the spermatogenic cells; *c*, an inner layer, the spermatoblasts. The latter are granular, indistinctly outlined, and show no signs of proliferation.

At the apices of the lobules the tubes become straight, join together to form larger tubes (vasa recta), and en-

ter channels in the mediastinum (rete testis). At the upper end of the mediastinum the channels of the rete unite to form from 13 to 20 larger tubes (vasa efferentia), which perforate the tunica albuginea and enter the epididymis. At first straight, they become convoluted and form a series of cone-shaped masses (coni vasculosi), which together form the globus major. Opposite the bases of the cones the efferent vessels open at narrow intervals into a single duct, which constitutes, by its complex convolutions, the body and globus minor of the epididymis. This tube, the convolutions of which are held together by fine arcolar tissue, is about 20 feet in length, and is continuous at the globus minor with the vas deferens.

The vasa recta and channels of the rete are lined by a single layer of flattened epithelial cells. The vasa efferentia and tube of the epididymis are lined by columnar ciliated epithelium, and their walls contain circularly arranged muscular fibers.

The vas deferens is a continuation of the tube of the epididymis. (See Fig. 1.) Commencing at the lower part of the globus minor, it ascends along the posterior border of the testis and inner side of the epididymis, and along the back part of the cord to the internal ring. From the ring it curves around the epigastric artery and descends into the pelvis at the side of the bladder to its base. In this situation it lies between the bladder and rectum and along the inner border of the seminal vesicle of the same side. Here it becomes enlarged to form the ampulla, then narrows and unites with the duct of the vesicula seminalis to form the ejaculatory duct. It is about 2 feet in length, the walls are thick and the lumen small, measuring 1/25 of an inch. The vas consists of three coats: 1, an external or cellular coat; 2, a muscular coat; and, 3, an internal or mucous coat, arranged in longitudinal folds and covered by columnar epithelium.

The blood-supply of the testis is principally from the spermatic artery, which arises from the abdominal aorta, and accompanies the other structures composing the cord through the canal. As it approaches the testicle it divides, some small branches continuing onward to supply the epididymis, while the larger ones perforate the tunica albuginea and enter the mediastinum to supply the glandular portion through the vessels of the

tunica vasculosa. The vessel does not always divide so high as is pictured in the text-books. This is shown in Fig. 2, where the artery was injected with mercury and then skiagraphed. The bifurcation takes place close to the testicle, a fact to be borne in mind when operating.

The spermatic veins commence in the testis and epididymis, pass out at the posterior border and ascend in the cord as the pampiniform plexus. (See skiagraph Fig. No. 3.) Finally, two or three larger veins are formed from the plexus, pass into the abdomen with the artery and unite to form the spermatic vein. This, on the left side, empties into the renal vein, and on the right side into the ascending vena cava.

The lymphatics of the testicle (see Fig. 4) commence as minute vessels around the seminal tubules. These coalesce and most of them pass through the septa into the mediastinum. Others pass outward to join the plexus beneath the tunica albuginea, which plexus also communicates with a more superficial one beneath the tunica vaginalis. In the mediastinum the deep and superficial sets unite to form from four to six trunks, which pass upward in the cord into the abdomen. On the left side these vessels enter the glands near the aorta and left renal vein, while on the right they empty into the lumbar glands just above the bifurcation of the aorta. Afferent vessels from the glands of both sides empty into the receptaculum chyli.

The nerves are derived from the sympathetic system, branches from the aortic, renal and hypogastric plexuses, forming the spermatic plexus, which descends upon the spermatic artery and artery of the vas deferens. They are not provided with ganglia and have not been traced into the tubules. The terminal filaments ramify on the surface of the tubules and are distributed to the blood-vessels.

Physiology.—The functions of the testicle are two in number: 1, the production of spermatozoa; 2, the formation of an internal secretion, which is necessary to normal metabolism.

The spermatozoa are formed in the seminiferous tubules by a series of changes which take place in the spermatoblasts, or cells of the internal layer. These changes are as follows: The cell first assumes a pear-shape, the pointed end containing the nucleus, being directed toward the basement membrane. This por-

tion forms the head of the spermatozoon. By a drawing out or elongation of the broad part of the cell the middle piece and tail are formed.

After puberty the semen is probably being constantly secreted, although most of the time in small quantities. As the spermatozoa are formed they are forced along the tubules by the pressure of accumulated secretion,

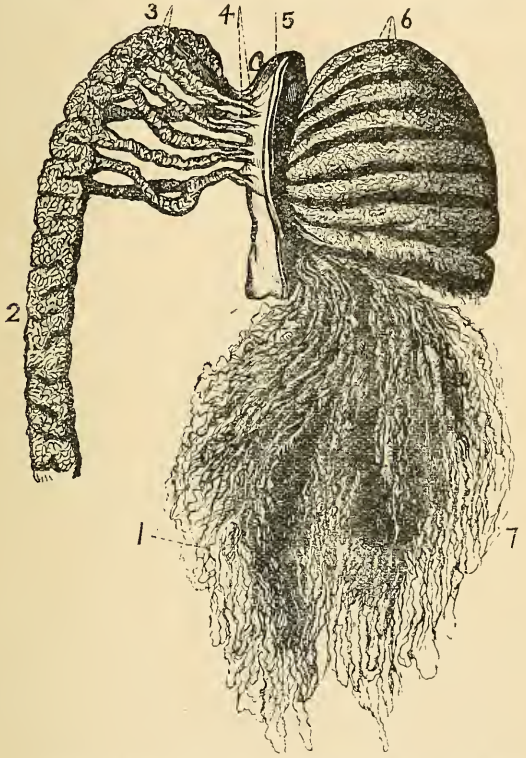

Fig. A.—Showing testicle partly macerated in KOH solution, which has loosened the connective tissue framework. (After Toldt.) 1. Tubuli seminiferi contorti. 2. Body of epididymis. 3. Coni vasculosi. 4. Vasa efferentia. 5. Tunica albuginea at hylum 6. Lobuli testis. 7. Tubuli seminiferi.

aided by the ciliary movements of the cells lining the vasa recta, vasa efferentia and tube of the epididymis. In the two latter its expulsion is also aided by contraction of the muscular fibers in their walls. From the vas deferens the semen passes into the ejaculatory duct

and seminal vesicle, in which latter, unless discharged immediately by emission, some of it is retained. It is probable, however, that the principal function of the vesiculæ seminales is secretory and that the ducts of the testes, rather than they, act as reservoirs for the semen.

The second and more important function of the testicles is the formation of an internal secretion. While the active principle of this secretion has never been isolated, nor the secretion itself been definitely proved to exist, experimental and pathologic evidence leaves little doubt as to its presence under normal conditions. Its importance to the normal development of the body is shown in cases of cryptorchismus, or where both testicles have been destroyed or removed before the age of puberty. These cases invariably show a lack of the sexual characteristics which are normally developed at this time. Its influence is also shown, though to a lesser degree, in cases where both organs have been removed after puberty in early and middle adult life. In many of these, sexual desire is entirely lost, the prostate and other parts of the remaining genital apparatus atrophy, and in a few there is a loss of the sexual characteristics which were formerly possessed. The experiments of Zath, reported in 1896, are interesting in this connection. Under daily injections of testicular extract the working power of a man's neuro-muscular system was increased 5 per cent., and during rest his powers of recuperation were greatly increased.

It can thus be seen that the preservation of this normal secretion is worthy of careful consideration, and the purpose of this paper is to emphasize its importance. In addition to the physiologic effects on the general metabolism produced by the removal of the testes, in many cases grave mental states, such as melancholia, are induced. Finally, there is the practical side, that many patients will not consent to the removal of both testes for tubercular disease until the bladder and prostate have become involved, or until they realize that death will result if the diseased organs are retained, while they will readily consent to the removal of both epididymi, upon the physician's statement that the testicles proper will be preserved.

Etiology. Age.—Tuberculosis of the testicle may occur at any age, but it is much more common during

early adult life, between the ages of 20 and 35 years, when the activity of the sexual gland is at its height. In Koenig's cases the different decades were affected as follows: Under 4 years, 3; between 20 and 30 years, 24; between 30 and 40 years, 8; between 40 and 50 years, 4; between 50 and 60 years, 4; between 60 and 80 years, 2. Of the latter, one was 67, and one 72 years of age.

The age statistics quoted by Senn from the various authorities are as follows: Sallerton in 47 cases observed the period of greatest liability to be between 20 and 30 years. Kocher from 50 cases also between 20 and 30 years, while Simonds, from an analysis of

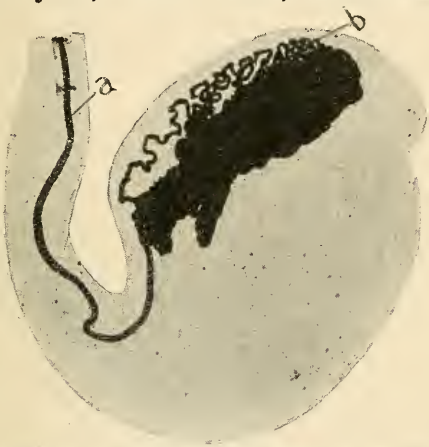

Fig. 1.—Skiagraph showing Vas and Tube of the epididymis injected with mercury. *a*. Vas. *b*. Tube of epididymis.

69 cases, found the greatest number between the ages of 40 and 50 years, with 20 to 30, and 30 to 40 years coming next in frequency.

Jullien reported 16 cases of tubercular testicle in infants, 6 of which were under 1 year of age, and Dr. Dreschfeld a case where the disease was present at birth. In one of Koenig's cases the disease was noted a few days after birth.

As regards the other extreme of life, Gibson has reported a case in a man aged 81 years. In the cases here reported the average age was about 33 years.

Hereditary Influence.—This may be shown in two ways: 1, where the disease is present at birth or develops

very soon after; 2, as an inherited condition of lowered vitality, in which there is a tendency to the development of tuberculosis, due, probably, to a lessened resistance of the tissues.

In perhaps the majority of the cases no tubercular family history can be obtained, this absence of hereditary influence being especially marked in cases which develop in adult life. In 10 cases of testicular tuberculosis in children, reported by Jullien and Lannelongue, 4 presented a distinct family history. In 5 of Koenig's cases, in which the disease was distinctly localized in the testis, and in which he believed it to have originated from pre-existing tubercular deposit, there was a family history in 3.

In 16 cases reported by Jullien, 6 were in patients less than one year of age. An inherited tendency is probably present where the disease develops so soon after birth.

Injury.—In many cases there is a history of traumatism preceding the onset of the disease. The injury in most cases, slight and insignificant, may be forgotten by the patient, who does not connect it with the onset of his trouble. In other cases the relation between the two is so striking and direct that it can not be overlooked. This etiologic factor is beautifully illustrated in Case 10, where the disease developed almost immediately after a kick in the testicle. The rule is that the tubercular process does not manifest itself conspicuously until at least six weeks or more have elapsed from the time the injury was received.

Previous Inflammatory Processes.—Of all affections of the genito-urinary tract, which predispose the testicle and epididymis to a subsequent tubercular infection, gonorrhea is the most important, either a gonorrheal epididymitis or a posterior urethritis. In 52 cases collected by Kocher, 14 had suffered from it previously. The tubercular process may follow the gonorrheal immediately, while the latter is yet in the acute stage, or at any time after the subsidence of the active symptoms. It must not be forgotten, however, in this connection, that the gonorrheal inflammation may be simply the means of lighting up a latent tubercular focus, which had been lying dormant in the epididymis for years, without, perhaps, the patient being aware of its existence.

The explanation of this phenomenon is simply that of a *locus minoris resistentiæ* left after subsidence of the acute inflammatory process. This area of diminished resistance may perhaps in some cases be a defect in the mucous lining, through which germs may enter from the surface. Tuberculosis of the testicle does not commonly follow the acute infectious diseases, even when these have been complicated by an orchitis. J. B. Shaw reports a case where it was supposed to have followed an attack of measles.

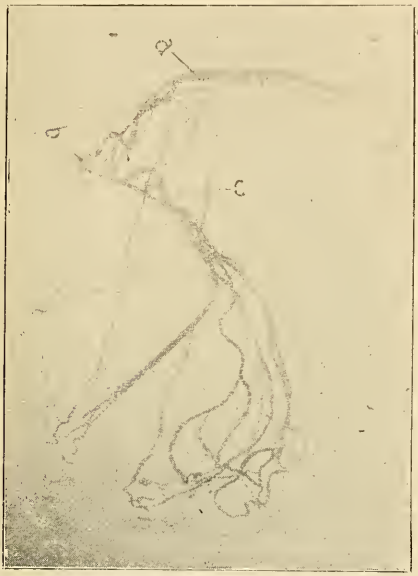

Fig. 2.—Skiagraph of Spermatic Artery injected with mercury. *a*. Spermatic Artery. *b*. Branch to epididymis. *c*. Branch to testicle proper.

Atrium of Infection.—This at the present time is undergoing most rigid scientific investigations. The channels through which infection may take place are, in order of frequency, as follows: 1, respiratory tract; 2, gastrointestinal tract; 3, genitourinary tract; 4, skin.

That the respiratory tract, with arrest of infecting organisms in the mediastinal glands, is the most frequent atrium of infection, is shown by the researches of Jens Bugge. This investigator has shown that 75 per cent. of all human beings who come to the post-

mortem table have had mediastinal glandular tuberculosis. As is well known, this disease may exist without producing any symptoms, and it will therefore be seen how readily a crypto-tubercular infection in this locality could precede a localized infection of the testicle. It is our belief that the mediastinal glands are the most common sources of supply for tubercle bacilli in the body.

Carious teeth with ulceration of the gums about them, and defects in the mucous membrane of the nose, mouth, tonsils and middle ear, with subsequent infection of the cervical lymph-glands may, especially in children, be the primary sources of infection.

That the gastrointestinal tract admits of infection from tuberculous material taken in as food, can not be questioned, but that it is attacked much less commonly than is generally supposed is proved by the infrequency of tuberculosis of the mesenteric glands. (Northrup and Boviard.) Dr. W. J. Mayo, of Minnesota, has found that in the rural districts, where milk is largely used as an article of diet, a localized tuberculosis of the intestinal mucosa is not very uncommon, but that the mesenteric glands are very rarely involved without a demonstrable lesion in the intestine. In this respect the intestinal tract differs from the respiratory, where in many cases no physical changes can be demonstrated at the point where the bacilli have gained entrance.

That infection can take place directly through the urinary outlet, the urethra, or through the genital outlet, the vagina, is generally admitted, and cases have been reported where it was transmitted from a tubercular uterus or vagina to the glans penis, or prepuce. (Jonin, Cornet.) Reclus denies that infection ever takes place in this way.

That tubercular infection is often admitted into the system through the skin is shown by the number of cases of the local disease among physicians, and in the children of tuberculous parents, these children so often developing lesions about the cheeks, lips and mouth.

The tubercle bacilli having gained entrance into the system, the next subject for consideration is: How do they find localization in the testis? There are a number of routes by which the infection may be carried to the

sexual glands: 1, by the blood-stream; 2, along the surface of the mucous membrane of the genito-urinary tract; 3, by the lymphatics.

1. Transmission by the blood-stream has been, by most authors, considered to be the most important. The bacilli contained in the blood localize in the epididymis at some point where there exists a focus of diminished resistance, either congenital, or produced

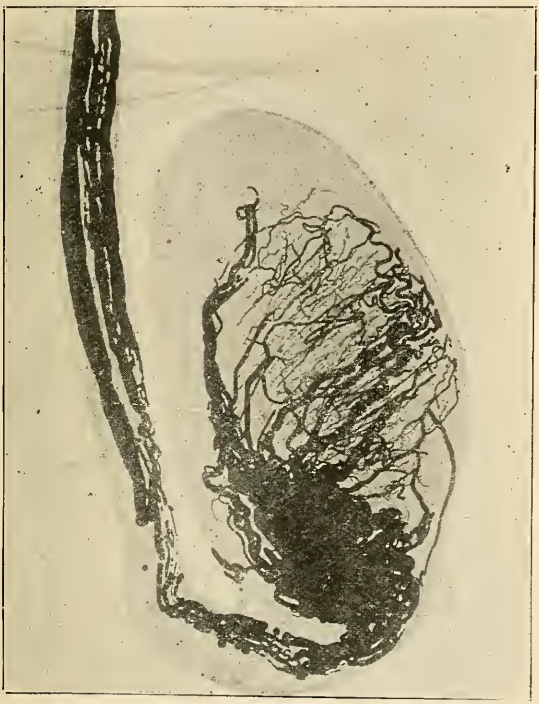

Fig. 3.—Spermatic Veins injected with mercury.

by previous injury or disease. The frequent localization in the epididymis is accounted for by the fact that the spermatic artery divides opposite that organ, and that the vessels of the epididymis are smaller and more tortuous than those of the vas or testicle proper, the current therefore being slower . (Saltzman.)

2. In some cases the infection undoubtedly travels along the surface of the mucous membrane. This view is supported by Koenig in his recent paper on the sub-

ject. He believes that in a very great majority of cases the testicular affection is preceded by tubercular disease higher up in the genito-urinary tract, especially in the vesiculæ seminales and prostate. In the 45 cases reported by him, these organs were involved 31 times. In the majority of cases, however, there were distant foci in the lungs, bones, glands, etc. Kocher holds the same view. Cayla thinks that a descending infection along the mucous membrane is most common, and believes that the infection travels in the same direction as the current of urine, and against that of the semen. His views are based on 100 sections, in which he observed that tubercular disease of the genito-urinary organs was always preceded by tuberculosis higher up.

Guyon and Lancereaux have observed that the process often begins in the vesiculæ seminales. Virchow has always held that the infection was a descending one, beginning in some of the higher genito-urinary organs. Saleron is opposed to this view, as in 51 cases examined by him, organs, other than the testicles and epididymis, were involved in only one case. Senn states that frequently the infection descends from the prostate, seminal vesicles or kidneys. Weigert (cited by Kocher) thinks that the prostate favors localization of all kinds of micro-organisms, and Keziwicki, in 15 autopsies on cases of genito-urinary tuberculosis, found the prostate involved 11 times.

M. Verneuil believes that infection often takes place during coitus, and gives anatomical reasons for his views. This seems very doubtful, however, when we consider the frequency of tubercular epididymitis in children. Furthermore, if this were the case, we should more frequently meet with tubercular lesions of the penis and urethra, for there must be ample means for inoculation in the abrasions of the urethral mucosa so commonly found in gonorrhea.

While we can undoubtedly have a descending infection, it is our observation and that of many other investigators, that the disease is usually an ascending one, the epididymis being affected primarily and the bladder, prostate, etc., secondarily, the process extending upward along the surface of the mucous membrane of the excretory duct.

3. Transmission of the infectious material to the

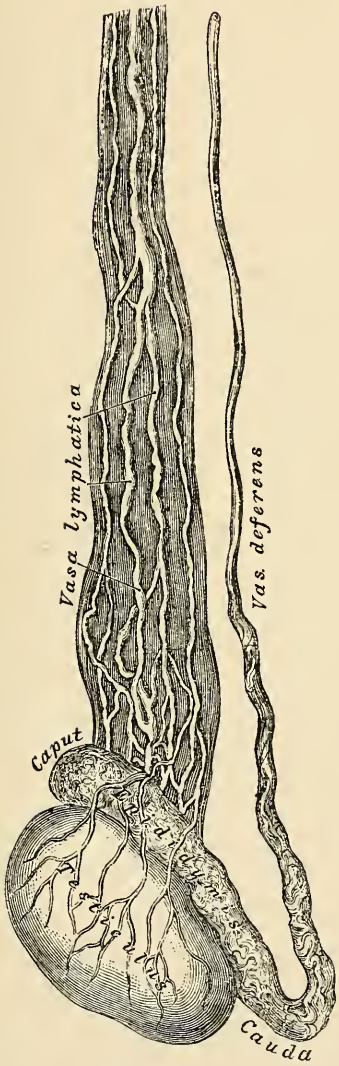

Fig. 4.—Lymphatics of testicle. (Heitzmann.)

testicle by the lymph channels, while usually given as one of the routes, must be very rare, as the lymph-current is directed away from the organ rather than toward it. No cases have been reported which show the infection to have taken place in this way.

Koenig thinks that in some cases the disease begins as a primary tuberculosis of the testicle, the infection having been carried to the organ some time before and remaining dormant until lighted up by the occurrence of one of the exciting causes, such as injury, acute inflammatory processes, etc. This view is based on the studies of Jani, who found bacilli in apparently healthy testicles of patients suffering from pulmonary phthisis. Koenig thinks that this may explain some cases where no atrium of infection can be demonstrated.

Association of Tuberculosis of the Testicle with Tubercular Lesions Elsewhere in the Body.—As stated above, in from 73 to 75 per cent. of persons dying from all causes, mediastinal glandular tuberculosis is present, and this in the majority of cases is probably the atrium of infection in the cases of testicular disease. The latter is not usually associated with pulmonary tuberculosis, though Reclus observed that 50 per cent. presented lung findings, and 2.5 per cent. of the pulmonary cases over 15 years of age suffered also from localization in the testicle. In his analysis of 500 cases of phthisis, 64 had involvement of the genito-urinary tract, 45 of the genital tract, and in 19 the testicles alone were affected. Simonds, from his post-mortem experience, found the genital organs involved in 2 per cent. of all tubercular children.

Tuberculosis of the lymphatic glands and bones is not often accompanied by disease of the genital organs.

In children, tuberculosis of the peritoneum sometimes coexists with disease in the testicles. Reclus thinks there is, in these cases, a communication between the cavity of the tunica vaginalis and the peritoneal cavity, the processus vaginalis.

Tillmans states that tuberculosis of the testicle almost always develops in persons already tuberculous, but this is not borne out by the experience of most surgeons.

In the majority of our cases the disease, so far as could be determined by physical examination and clinical history, was primary in the epididymis.

As a Part of a General Miliary Tuberculosis.—This

is of but little interest to us in the consideration of this subject, because when it is present, it is overshadowed by the manifestations of the disease in other parts. Koenig states that the testicles are rarely affected in general miliary tuberculosis. When the involvement does occur, both testicles and both epididymi are affected simultaneously. Hutinell and Deschamps state that tuberculosis of the testes in children is seldom primary, but usually a part of a general infection.

Occurrence of the Disease in Misplaced and Inverted

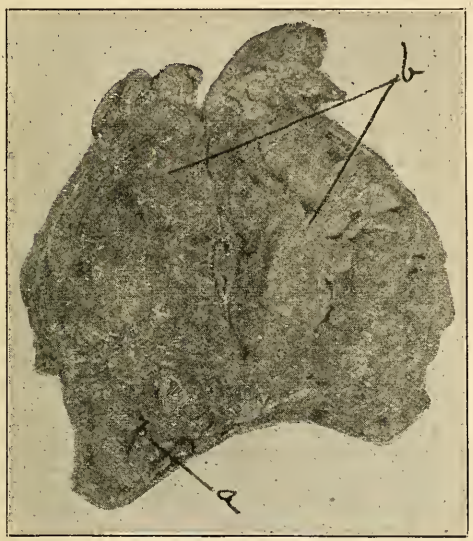

Fig. 5.—Showing involvement of testicle proper and epididymis, the former by extension from latter. *a.* Globus Major. *b.* Testicle proper.

Testicles.—No authentic case of tubercular disease affecting an undescended testicle is on record, although several cases supposed to be such have been reported, one by G. Fischer, in 1864, and another by F. Roberts. The details of the cases in these reports are indefinite, so that it is very doubtful if they were really cases of tuberculosis. No satisfactory explanation of the apparent immunity possessed by these misplaced organs has been offered. In a case reported by Rushton Parker, of general tuberculosis, the left testicle was

absent, and the left seminal vesicle free from disease, while the right testicle was present and the right vesicle involved.

Inversio-testis was noted by Koenig five times in his cases, and it is thought by him to be a predisposing cause. Case No. 13 of our series presents this anomaly in the testicle first attacked.

The right testicle is attacked first in the majority of cases. Rintelen (quoted by Senn) observed in 15 cases that the right organ was affected first in 10, and the left in 5. In 10 of our cases, in which an accurate history of the onset could be obtained, the right was involved first in 8, and the left in 2. Whichever organ is primarily attacked, it is usually only a question of time before the other becomes similarly diseased, this extension being due, in all probability, to transmission of the infectious material along the vas of the affected side to the prostatic urethra and down the opposite vas to the epididymis on the other side. Jullien states that in children the left testis is commonly affected first.

Pathology.—There has been and still is a marked diversity of opinion as to the location of the primary focus in the testis, and its method of extension subsequently, and a still greater divergence as to the relation which the testicular disease bears to tuberculosis of other portions of the genito-urinary tract, or of more distant portions of the body.

The epididymis is, in a very large percentage of the cases, first attacked. Cases have been reported (Reclus) in which the disease began in the testicle proper, but they are so very rare that practically they may be excluded. Gilbert Barling, M.B., reports a case of acute tubercular disease of the bodies of both testicles. In this case castration was performed, and caseous areas and tubercle bacilli were found in the bodies of the testicles, the epididymi not being involved. There was, however, a suspicion of phthisis in the right apex.

Most authors hold that in the majority of cases the globus major is first attacked, the infection spreading from there to the body and globus minor, and finally to the testicle proper. From our own observations, however, we would say that in adult cases the globus minor is most frequently primarily attacked, the body, globus major, and mediastinum testis becoming affected secondarily by continuity of tissue, or by extension

along the surfaces of the seminal ducts. In children the primary nodule has usually been in the globus major.

The morbid anatomy of a testicle, the seat of tubercular disease, varies greatly, depending on the stage to which the process has advanced, the anatomical

Fig. 6.—Tuberculosis of Tunica Vaginalis. *a*. Tubercular areas. *b*. Epididymis. *c*. Healthy Tunica Vaginalis.

distribution of the lesion, and the presence or absence of secondary infection. We will not consider here the testicular affection which is a part of a general miliary

tuberculosis. In the majority of the cases the epididymis is alone involved, and presents in the early stages one or more small nodules, situated in the globus minor or major. Later other nodules form in different parts, which enlarge and coalesce, converting the epididymis into a hard, irregularly shaped mass, which, at a still later period, after caseation and softening have taken place, may be soft and fluctuating. Section of the epididymis in the early stage shows the nodules to be composed of a homogeneous material, which has largely taken the place of normal tissue, the latter being compressed and infiltrated with inflammatory products. The capsule of the epididymis is greatly thickened, and the vas, near its attachment to the globus minor, may be thickened and nodular, due to the infiltration of the tissues surrounding it, or to an involvement of its walls proper. Later the small nodules have fused with one another to form larger ones, the homogeneous material may be liquefied so as to resemble pus. Fibrous tissue may have been formed around some of the softened areas, and between them islands of normal or altered tubular tissue may be seen. The capsule now presents caseating areas, and the cellular tissues of the scrotum in its neighborhood may be edematous, infiltrated and adherent to it and the skin. When secondary infection has taken place, and frequently without it, the pus may have burrowed toward the skin, the abscess cavity ruptured, and a discharging sinus surrounded by thick fibrous walls formed. The fibrous capsule which surrounds the caseous areas may become infiltrated with lime salts, and in this way a thick shell of calcareous material, surrounding it or perhaps the entire epididymis, is formed. This was beautifully illustrated in a case recently reported by Dr. H. G. Wells. In other cases the disease is not limited to the epididymis, but has also involved the testicle proper by continuity of tissue. (See Fig. No. 5) In these the epididymis presents the appearances described above, and scattered through the testicle proper are numerous small tubercular nodules in all stages of development. These nodules are most abundant at the periphery of the organ, where they are very small, and on section present the homogeneous appearance characteristic of young tubercles. In the mediastinum testis they are apt to be larger and caseous, showing

that this was the part first affected by extension from the epididymis. The distributions of the lesions in the testicle proper indicate that the extension took place along the seminiferous tubules. Later, in the course of the disease, the nodules here, as in the epididymis, coalesce to form larger ones, these caseating, becoming encapsulated, or frequently breaking externally. Calcareous deposit may take place either in the fibrous capsule or throughout the broken-down nodules. The glandular portion is wholly or in part destroyed. The tunica vaginalis usually presents evidences of chronic

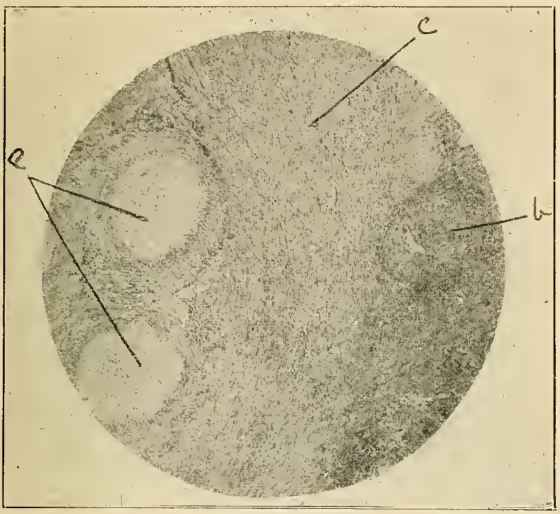

Fig. 7.—*a*. Cross sections of tube of epididymis. *b*. Tubercle with giant cell. *c*. Old fibrous tissue. From Case 11.

inflammation, thickening and adhesions between the visceral and parietal layers, or, in some cases tubercular lesions. This involvement of the tunica vaginalis by the tubercular process is well illustrated in Fig. 6, which is a photograph of a testicle removed by Dr. Oswald. In this case the entire testicle had to be removed on account of the extensive involvement. An effusion into the cavity of the tunica vaginalis is present in most cases, but is usually small in amount.

Spermatic Cord.—This is affected in a considerable proportion of the cases, but usually not throughout its entire length. The parts most apt to be involved

are either or both of the extremities, the intermediate portion remaining free. In some cases, however, the entire vas is thickened and nodular (Senn).

The tubercular deposits in the cord are usually situated in the neighborhood of the vas, the infection having taken place by extension along the surface of its mucous membrane from the infected epididymis. All stages of development of the tubercular lesions are found here as in the epididymis, but in most cases have not advanced to the same stage. The mucous lining of the vas is greatly thickened, the outer layers of the wall being affected to a lesser degree. The connective tissue surrounding it may also present nodules and caseous areas, but much of the thickening is due to edema and inflammatory exudate.

Vesiculæ Seminales.—The vesiculæ seminales come next to the vas, as regards their frequency of secondary involvement. While usually these organs are involved only after the vas has become more or less extensively diseased, this is not always the case. The process in them may be far advanced without the vas being affected at all, or the latter may present lesions which have evidently developed at a later period than those in the vesicles. Later abscess may form and the pus be discharged through the bladder or rectum, or externally through the perineum.

The Prostate.—This organ follows the vesiculæ seminales in order of frequency of involvement, though some observers (Kocher) state that it is affected much oftener than is commonly supposed, the disease in it being overloked on account of the absence of symptoms and physical signs in the early stages. The process here is the same as in other parts, the deposits going on to caseation and suppuration, and later rupturing into the rectum, urethra or externally. In most cases the prostatic lesions are in an earlier stage of development than those in the epididymis. The prostate and seminal vesicles may be affected unilaterally, and when this is the case, the side presenting the lesion usually corresponds to that of the diseased epididymis. It is more common, however, for the entire prostate or both vesicles to be affected.

Microscopic Appearances.—The series of pathologic changes which follow the lodgement of the bacilli in the tissues is the same as in tuberculous lesions else-

where in the body, modified somewhat by the anatomical structure of the organ. The bacilli, having gained access to the circulation by one of the channels mentioned above, lodge in the walls of the smaller blood-vessels of the epididymis and there produce their characteristic reaction. (Nepveau.) As to the exact situation of the starting-point of the process, there is great difference of opinion, Malassez and Reclus locating it in the walls of the seminal tubules; Virchow, Tizzoni, and Gaule, in the intertubular connective tissue; while Langhans, Curling, Kocher, and others believe it to be in the

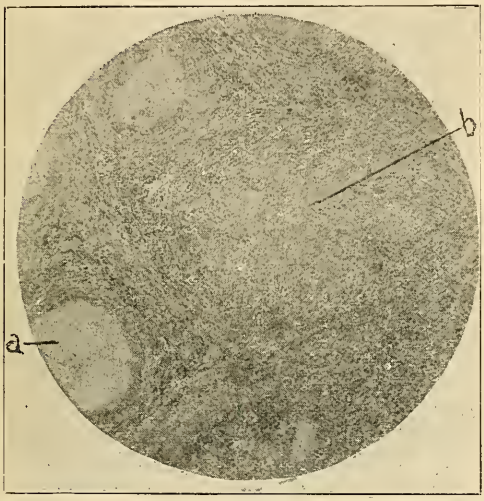

Fig. 8.—Showing young tubercle between coils of tube of epididymis. *a.* Tube of epididymis. *b.* Tubercle. From Case 11.

interior of the tubules themselves. Hutinel and Deschamps found the primary focus in the perivascular spaces in the cases examined by them. As in the majority of cases, the infection probably takes place through the blood-current, it seems reasonable to suppose that the primary lodgment of the bacilli is in the intertubular connective tisue of the epididymis, and this view is certainly supported by studies of tuberculosis in other organs.

The specific irritation set up by the bacilli and their products causes, first, an increased vascularity of the

part, and then proliferation of the fixed-tissue cells, and emigration of leucocytes from the capillaries. In this way nodules of the so-called tubercle tissue are produced between the coils of the tube of the epididymis (Fig. 7), widely separating them from each other and encroaching upon their lumina. This tubercle tissue consists essentially of: 1, epithelioid cells, derived from the fixed tissue cells, connective tissue and endothelium of the blood-vessels and lymph-spaces; 2, the reticulum, in the meshes of which the epithelioid cells lie. This reticulum may be derived from the newly proliferated endothelial cells, or it may be the remains of the tissues which previously existed. Later, in addition to the tubercle tissue, the leucocytes, which at first were present in small numbers, become more numerous, especially at the periphery of the nodule. (Fig. 8.) It is in this so-called round-celled infiltration that we find the plasma cells, sometimes in great numbers and usually arranged in groups. These, according to different authors, may be derived either from the lymphocytes of the blood, or from the connective-tissue cells. Their function at present is doubtful, some claiming that they possess phagocytic properties; others that they have no such function, and are destined to become converted into fibrous connective tissue. Scattered through the tissue, usually occurring singly rather than in groups, are found the mast cells of Ehlrich, which are also of doubtful origin and function. The epithelioid cells may be mononuclear or polynuclear, giant cells (Fig. 9), which latter are formed by the proliferation of the nucleus of the cell without division of the cell body, and are usually found in the center of the tubercle, surrounded by the mononuclear epithelioid cells.

When the individual tubercles have attained a certain size, caseous degeneration sets in, due both to the action of the toxin and to the gradual shutting off of the blood-supply, and it is at this point that the process may be arrested by encapsulation, or that secondary infection, with destruction of a part or whole of the organ, may occur. If encapsulation takes place, the connective-tissue cells which have proliferated at the periphery of the tubercle, or tubercles, gradually contract and become converted into a dense fibrous tissue, in this way causing

an arrest of the process, the nodules remaining for an indefinite period of time.

During the progress of the changes described above, the coils of the tube of the epididymis are encroached upon and present a variety of changes. The epithelium may have entirely desquamated at the site of involvement, the cells lying loose in the lumen, which may be greatly dilated and contain pus-cells and granular debris, the remains of degenerated cells and spermatozoa. In other sections the lumen is filled with caseous material, which has probably come from the tubercles in the walls, rather than from the interior of the tube pri-

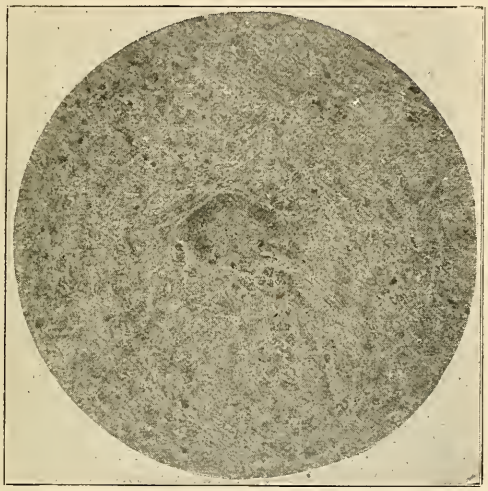

Fig. 9.—Giant cell in center of Tubercle. From Case 11.

marily. The duct may present in certain parts great dilatation and be filled with purulent material and spermatozoa. In these latter the epithelium may be intact or desquamated in parts.

Tubercle bacilli can usually be demonstrated in the sections, especially where the process is in the early stages. Later, after caseation has taken place, they may be so few in number as to escape observation, even on careful examination.

Reclus has described a rare pathologic condition in tuberculosis of the testicle, in which, instead of the changes described above, the epididymis presents a

reticular arrangement, the alveoli of which are filled with pus.

Symptoms.—These differ materially, as in tuberculosis of other organs, varying with the rapidity of advancement of the process, the presence or absence of mixed infection, and again as the disease is primary or secondary in the testicle.

The symptoms of onset vary greatly at the different periods of life. In infants and young children the parents' attention is usually first called to the presence of a small nodule in the epididymis, the child having manifested no other symptoms, except perhaps slight tenderness in this region.

In adults the initial symptoms may be sudden or gradual in their onset, the latter being much the more common of the two. When associated with mixed infection, the onset is stormy, and there are all the manifestations of an acute epididymitis, resembling the gonorrheal form. (Case 10.) Abscess formation may be rapid, and the pus find its way to the surface in a short time, leaving a sinus that heals slowly. Instead of breaking externally, the burrowing may be in the direction of the testis proper, and a portion or all of this organ be destroyed. Rupture into the cavity of the tunica vaginalis must be extremely rare, if it ever occurs.

When unassociated with mixed infection, the onset is slower, and many of the patients come to the physician for the first time because of the nodule which they have accidentally discovered in the epididymis. They are usually unable to say how long it has been there, but in some instances date its development from a slight injury or a gonorrheal epididymitis. The nodule or nodules are at first painless and only slightly tender on compression; but usually after a short time the patient experiences a dull, aching pain in the testicle, brought on or aggravated by exercise. This pain may be referred to the testicle or upward along the spermatic cord, sometimes even extending into the ilio-lumbar region of the same side. It is rarely severe, and may be entirely absent when the patient is at rest.

A urethral discharge, usually whitish and mucoid in character, has been noted in a considerable proportion of the cases, usually quite early in the course of the disease. Instead of being white, it may be purulent or

even bloody. Various theories have been advanced as to the origin of this discharge, some claiming that it is due to tuberculosis of the prostate, vesiculæ seminales, or the prostatic urethra, while others believe it is caused by a catarrhal condition of the posterior urethra and seminal vesicles. The latter is probably the true explanation, as it disappears after castration or epididymectomy. Symptoms of vesical irritation are present in the great majority of cases without mixed infection, and in some they are the first to attract the patient's attention. At first, there may be slightly

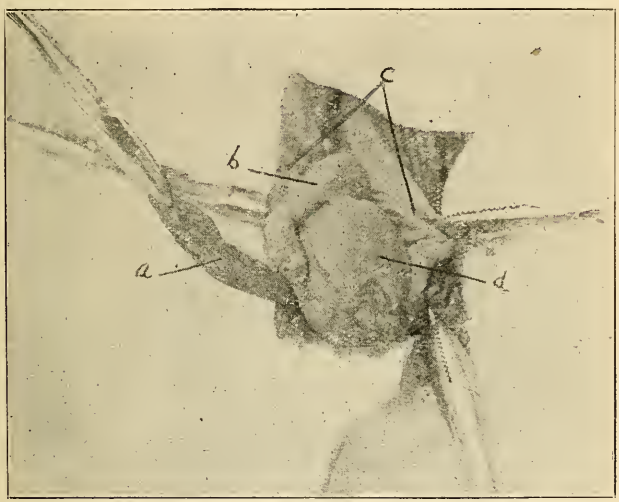

Fig. 10.—Globus Minor and body of epididymis dissected from testicle proper. *a.* Globus Minor and body. *b.* Globus Major. *c.* Reflected tunica Vaginalis. d. Testicle proper.

increased frequency of urination, with perhaps a little burning during the act, referred to the base of the bladder. As the case progresses, the irritability becomes more marked until the patient is unable to retain his urine more than fifteen or twenty minutes at a time, involuntary passage taking place if he attempts to do so. Later, also, tenesmus develops, and may become very severe. The fact that vesical symptoms are usually absent in the cases with secondary infection is to be explained, in all probability, by the edema and swelling of the vas, which does not permit the irri-

tating material to pass through it to the vesiculæ seminales.

Hemorrhage from the urethra may occur early or late, and is usually not profuse. The blood is passed with the urine, and without obvious cause, in this latter respect differing from the hemorrhage of renal calculus, which is brought on by severe exercise, such as horseback riding, etc. The source and cause of this hemorrhage are somewhat uncertain, but we believe it is due, as are the symptoms of vesical irritation, to the irritating action of the products of the tubercular process, which are discharged into the prostatic urethra through the vesiculæ seminales. This discharge produces a catarrhal condition of the mucous membrane in the posterior urethra and trigone of the bladder, with, in many cases, erosions and superficial ulcerations. That the vesical irritation and hemorrhage are not manifestations of a tubercular process in the bladder and prostate, we are convinced from clinical observation, as in almost all cases in which these symptoms are present, there is an immediate cessation of them after castration or resection of the epididymis, which could not possibly be the case if they were due to tuberculosis of these parts. This rapid subsidence of the symptoms after operation is illustrated in the majority of cases here reported, but strikingly so in one operated upon 10 years ago. In this case the patient was obliged to urinate every 15 or 20 minutes and was entirely incapacitated for his duties as clergyman. Unilateral castration was performed and vesical symptoms disappeared almost immediately. In a letter received several days ago he reports that his weight is now 260 pounds; there has never been a recurrence of the disease or bladder irritability, and since the operation he has worked steadily.

Hydrocele, which is present in about one-third of the cases, may have been the first symptom to attract the patient's attention. It is rarely large, when due to tuberculosis in the epididymis, and there is but little difficulty presented in diagnosis.

At varying intervals from the onset of the trouble softening of the deposit in the epididymis takes place. This, in the acute cases, may be a few weeks, while in the more chronic ones it may not occur for months or even years after the onset. When the abscess is about to rupture, the skin of the scrotum over the fluctuating

mass becomes adherent to it, bluish in color, and finally perforates by a small opening, through which the characteristic caseous material is discharged. There is usually no pain attending this process and but little tenderness, except where it is associated with mixed infection, in which event we have all the manifestations of

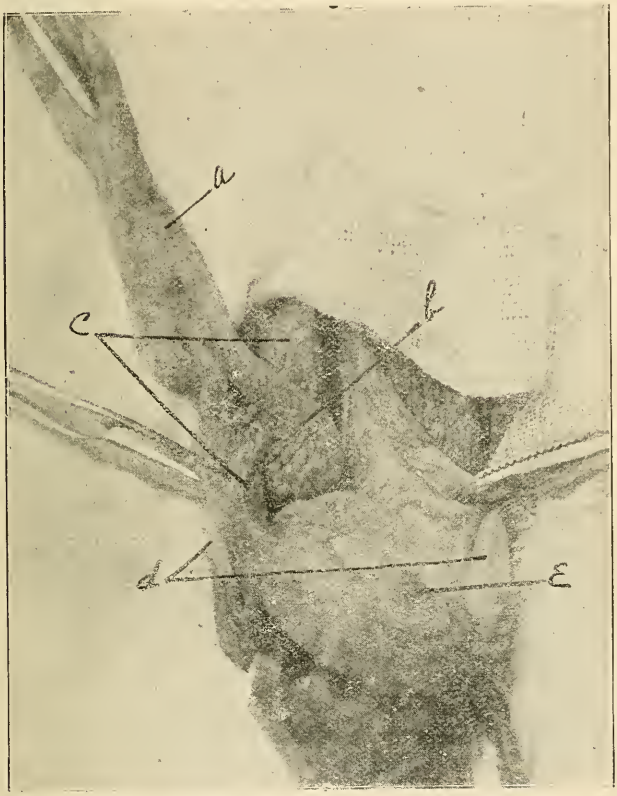

Fig. 11.—Showing epididymis freed from testicle proper. *a.* Epididymis (body). *b.* Globus Minor. *c.* Spermatic artery and veins. *d.* Tunica Vaginalis reflected. *e.* Testicle proper.

an acute cellulitis. The sinuses formed by rupture of the abscess cavity may be single or multiple, and situated in different parts of the scrotum. They usually remain open indefinitely, and show no tendency to close spontaneously. The amount of discharge is slight.

Hernia testis is rarely seen at the present time, probably because the cases are operated on at an early stage. It is consequent upon the rupture of a tubercular abscess situated in the testicle proper, and consists simply of tuberculous granulation tissue, which is extruded through the opening, forming a fungus mass of greater or less size.

Constitutional symptoms are present in the majority of cases, though they differ greatly in degree. Some patients present the typical tubercular appearance, while others appear to be in perfect general health. In most of the cases, after the process has been present for some time, there is loss of weight and strength, with perhaps some evening temperature, rarely exceeding 100 F., and night sweats.

The sexual desire is usually unaffected, except in the very severe cases, even though, when both epididymi are involved, there may be no seminal discharge during intercourse.

Examination of the patient may reveal the presence of some old tubercular lesions on other parts of the body, such as lupus scars, cicatrices of the neck, or perhaps the evidences of a healed osteomyelitis. In Case No. 10 of our series the diagnosis at first was somewhat doubtful, because of the rapid growth of the testicular tumor, but the presence of a tubercular tendo-synovitis of the hand cleared up all doubt as to its nature.

Rectal examination, for the purpose of ascertaining the condition of the vesiculæ seminales and prostate, should always be made. The seminal vesicles are frequently involved, or if only one is affected, it is more likely to be the one on the side of the affected epididymis. In the early stages the vesicle is soft, swollen, somewhat painful to pressure, and can be outlined throughout its entire length by the examining finger. Later, nodules develop in it, and it presents a very irregular shape, hard, with, perhaps, fluctuating areas in different parts. When both are affected, they can be plainly felt converging toward the prostatic urethra.

It is more difficult to determine tubercular disease of the prostate, especially in its early stages, because the process is usually situated deep in the substance of the gland. In the early stage of the prostatic disease the gland may be somewhat swollen and tender to pressure, while later, when the process is farther advanced,

it may be nodular, and present fluctuating areas. Either lateral lobe may be affected singly, or if the entire gland is involved, it may be more advanced on one side than on the other. The inguinal lymph-glands are rarely involved in tubercular disease of the testicle.

Uranalysis.—The condition of the urine will depend on the stage to which the disease has advanced. Usually when the patient presents himself for treatment small quantities of pus and blood will be found in the centrifuged specimen. By staining the pus for tubercle bacilli they can usually be demonstrated, although al-

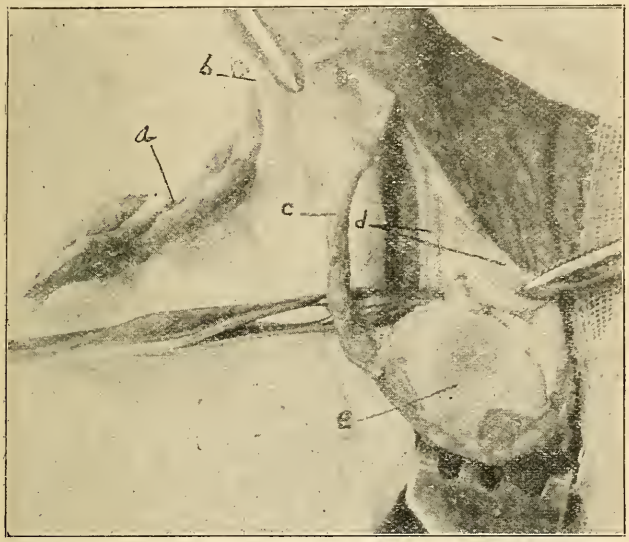

Fig. 12.—Showing entire epididymis free from testicle proper and vas isolated. *a.* Epididymis. *b.* Vas deferens. *c.* Spermatic vessels. *d.* Tunica Vaginalis (reflected). *e.* Testicle proper.

most always in very small numbers. It is of great importance in searching for the bacilli to use special staining methods, so that the smegma bacillus will not be mistaken for the tubercular germ. Various processes for differentiating these two organisms have been proposed, the most reliable being that of Bunge and Trantenroth, which consists of extracting the fat from the bacilli by allowing the preparation to remain for three hours in absolute alcohol, then treating it for fifteen minutes with a 5 per cent. solution of chromic

acid, and washing in several changes of water. The preparation is then to be stained with carbol-fuchsin, destained in dilute sulphuric or pure nitric acid for one to three minutes, and further destained and at the same time counterstained, by immersing in a concentrated alcoholic solution of methylene blue for five minutes. By this means the tubercle bacilli retain the stain, while the smegma bacilli become decolorized. Soudan iii, in saturated alcoholic solution, may also be used for differentiating the two.

Complications.—The routes by which extension of the tubercular process takes place are at present the subject of much dispute, many authors claiming that the disease exists primarily above and extends downward to the epididymis along the surface of the mucous membrane, extension, therefore, in an upward direction not taking place. As stated above, it is our opinion that the primary focus is in the epididymis, and that subsequently extension takes place along the lumen of the vas to the vesiculæ seminales, prostate, and in a few cases to the bladder, ureters and kidney.

Jacobson says that after the disease localizes itself in the epididymis it may spread by way of the lymphatics, but this is a very rare exception to the general rule. That it may in rare cases extend by the lymphatics is shown in Sommers' case (quoted by Senn) of a man, aged 36 years, who suffered from tuberculosis of both testicles. The retroperitoneal glands became involved, and later pulmonary tuberculosis developed. In this case the testes were primarily affected, the epididymis remaining free from disease throughout.

Pott's disease of the spine has frequently been observed to follow tuberculosis of the testicle, and this, as well as the cases of general miliary tuberculosis which occasionally develop, must be explained by dissemination of the infectious material through the blood-stream.

DIFFERENTIAL DIAGNOSIS.

In acute cases, where the symptoms come on suddenly and with great intensity, the diagnosis from gonorrheal epididymitis may, at first, be difficult. The principal points to be considered are:

1. The presence of an active gonorrhea, the discharge of which may have suddenly disappeared just before the onset of swelling in the epididymis.

2. Examination of opposite epididymis, vesiculæ seminales and prostate shows absence of nodules.

3. Previous history of patient. In tubercular disease there is frequently a history of recurring mild attacks of epididymitis, or enlarged cervical glands in childhood, osteomyelitis, etc. These are more likely to be absent in the gonorrheal cases.

4. Occasionally it may be impossible to make an immediate diagnosis, and in these we must await further developments, which will occur after the acute swelling has subsided. The tuberculin test might be valuable here, and in all cases where a urethral discharge is present a bacteriologic examination should be made.

Syphilis.—This disease may affect either the testicle proper or the epididymis, or both, in which latter case they are simultaneously involved.

Syphilis of the Epididymis.	*Tuberculosis of the Epididymis.*
1. Infrequently localized.	1. Frequently localized.
2. Diffuse or nodular enlargement, usually the former.	2. Usually nodular. In most cases begins in globus minor, but may commence in globus major.
3. Epididymis not sensitive to pressure.	3. Almost always some tenderness on pressure.
4. Almost always painless.	4. Usually slight aching pain after exercise.
5. No thickening of the spermatic cord.	5. Spermatic cord frequently thickened and nodular.
6. Vesiculæ seminales not involved.	6. Vesiculæ seminales may be nodular.
7. Usually no vesical symptoms.	7. Almost always symptoms of vesical irritation and frequently hemorrhage.
8. Rapid disappearance of lesions under KI and mercury.	8. Antisyphilitic remedies have no effect.
9. Frequently evidence of syphilis elsewhere in the body.	9. No such evidences; may be signs of old tubercular lesions in the lungs, glands, etc.
10. No tubercle bacilli in the urine.	10. Tubercle bacilli may frequently be demonstrated in urine.

Syphilis of Testicle Proper.	*Tuberculosis of Testicle Proper.*
1. Usually begins in the body of the testicle.	1. Body of testicle never primarily affected. Always secondary to epididymitis.
2. Usually diffuse involvement, rarely circumscribed.	2. Disease nearly always circumscribed, having extended from the hilum.
3. Sinuses rarely present, and if they do exist, usually last but a short time.	3. Sinuses more common, and they persist indefinitely.
4. Fungating form quite common.	4. Rare.
5. Usually definite history of primary and secondary manifestations.	5. No such history.
6. Yields promptly to antisyphilitic treatment.	6. No effect from antisyphilitic treatment.

Sarcoma and carcinoma are anatomically two distinct and separate diseases of the testicle. Clinically and practically, however, from the standpoint of diagnosis and treatment, they may be considered as one.

Malignant Disease of the Testicle.	*Tuberculosis of the Testicle.*
1. Usually begins in the body of the testicle as a hard, smooth swelling, which later becomes soft.	1. Tuberculosis always begins in the epididymis as a nodular enlargement.
2. Growth is very rapid, except in the rare scirrhus form.	2. Growth is slow.
3. May attain a very large size.	3. Never attains great size.
4. No inflammatory symptoms present during rapid growth.	4. Usually some inflammatory manifestations, which may be violent, if mixed infection takes place.
5. Veins of scrotum enlarged and prominent. Skin thin and dark colored.	5. Veins not enlarged. Skin, if affected, is thickened and adherent to the epididymis.
6. Tumor not tender to pressure.	6. Nodules usually tender.
7. Vesical symptoms not marked.	7. Vesical symptoms always prominent.

8. If fungating, the ulcerated mass bleeds in a characteristic way.	8. Ulcerating surface has no tendency to bleed profusely.
9. Cord is much more often enlarged and swelling is smooth and even.	9. The cord is nodular and hard.
10. Glands above and below Poupart's ligament may be involved.	10. Almost never involved.
11. May be metastatic tumors in lungs, abdomen, etc.	11. Sometimes evidences of old tubercular lesions elsewhere, as lupus scars, cicatrices in the neck, etc.
12. No tubercle bacilli in urine.	12. Bacilli often present.

In fibrous induration of the epididymis, due to some previous acute or subacute inflammation, the epididymis, while hard and thickened, is not usually nodular, history of the case is entirely different from that of a tubercular disease.

Of the benign tumors of the testicle, fibromata, enchondromata and osteomata are of such rare occurrence that they need not be considered in the differential diagnosis. Enchondroma and osteoma are sometimes secondary developments in sarcoma, adenoma and myxoma. Myomata have been described, but are very rare.

Adenomata, when they undergo cystic degeneration, may have to be considered in making the diagnosis.

Hydrocele usually presents no difficulty in diagnosis, but it must be remembered that it is often a part of the tuberculosis of the epididymis and testicle, as is serous pleural effusion of pulmonary tuberculosis.

Prognosis.—In tuberculosis of the testicle the prognosis depends upon: 1, the age of the patient; 2, whether the infection is simple or of a mixed character; 3, the location of the primary focus of infection; 4, whether or not other portions of the genito-urinary tract or more distant parts of the body are involved.

The prognosis in children in localized disease of the epididymis, or even where it has extended into the testicle proper, with or without mixed infection, is usually favorable. Encapsulation takes place in the majority of cases without pus infection, and a portion of the testis is preserved. Even where secondary infection has taken place and the abscess cavity discharged

externally, we can always hope for the preservation of at least a small portion of the glandular structure.

This tendency in children to encapsulation and limitation of the process is the same as that observed in tuberculosis of other organs in them, with the exceptions of tubercular meningitis and, to a lesser degree, osteomyelitis.

In adult cases many complications are apt to develop, and it is on these that the prognosis will in large part depend. The most important are: 1, abscess formation with resulting sinuses of the scrotum; 2, involvement of the seminal vesicles and prostate; 3, tuberculosis of the bladder (rare). In addition to these we may have foci develop in any other part of the body, and even general miliary tuberculosis has been known to follow a primary lesion in the epididymis. Whether the affection of the seminal vesicles or prostate precedes or follows the testicular disease or not, the clinical fact remains the same, the removal of the testicle or epididymis causes, in a large percentage of the cases, a complete subsidence of the vesical and prostatic symptoms, and a healing of the tubercular process in these parts. From the symptoms presented by some of the patients who have come under our care, it seemed certain that the tuberculosis had extended to the mucosa of the bladder, but on removal of the diseased testicle or epididymis they entirely subsided. While the prognosis is favorable in prostatic and seminal vesicle involvement, it is distinctly unfavorable when the disease has extended to the bladder. In these cases it very frequently further extends to the ureters and kidneys, and the patient soon succumbs to renal or general miliary tuberculosis.

If the epididymis, which is primarily affected, be removed early, it is probable that the other testicle will not become involved. Should it, however, become implicated, the urinary and vesical symptoms will recur and bacilli will again be found in the urine.

As regards life, Jacobson says: "It is to be looked upon as, if left to itself, an ultimately fatal disorder." This, we believe, is an exaggeration, and is by no means invariably the case, as in some the process becomes encapsulated and remains so throughout life. Even where both testicles are involved and discharging sinuses present, the general health may remain good indefinitely, as in a case reported by E. Albert of ten years' standing.

Tubercle bacilli can, in some cases, be demonstrated in the semen, and in this way infection may be transmitted to the female. It is interesting to observe that Jäckh found tubercle bacilli in the semen from healthy testicles in cases of pulmonary tuberculosis.

Treatment.—This may be divided into 1, palliative; 2, radical.

Under palliative treatment we recognize, *a,* rest; *b,* support to the diseased organ; *c,* constitutional treatment; *d,* the various injection methods, with iodoform, chlorid of zinc, etc.; *e,* the method recently advocated by Mauclaire, which consists in excising a section of the spermatic cord between two ligatures.

Radical treatment may be, *a,* orchiectomy; *b,* epididymectomy, either partial or complete, with excision of a part or whole of the vas deferens; *c,* incision and drainage, with or without curettage or cauterization with the thermocautery, chlorid of zinc solution, etc.

The disease in children, as before stated, has a tendency to rapid encapsulation, circumscribing the process to a local caseous nodule in the globus major or minor or, in some cases, even extending into the mediastinum testis, but occasionally there is complete destruction of the epididymis and glandular portion of the testicle proper, nothing remaining after a time but an abscess cavity. In children, too, there is a much greater likelihood of mixed infection than in adults, and it is this which usually causes the rapid destruction mentioned above. Felizet years ago made the statement that in acute genital tuberculosis of children castration is the only operation to be considered, and this statement has never been contradicted. (Longuet.) If suppuration, with destruction of the testicle, has already taken place when first seen by the surgeon, incision and drainage may be the only operation necessary. Early incision and drainage, without curettage, is urgently indicated in children where secondary infection is present to prevent the destruction of the glandular portion, which may take place without it. The rule is, in infants and children, that no radical operation is indicated, and the treatment of these patients should be the same as for tuberculosis of the lymphatic glands, namely, syrup of the iodid of iron, cod-liver oil and calcium lactophosphate. Epididymectomy is practically never called for.

The course of the disease is so varied in adults, from

an acute inflammatory process to a chronic indolent, almost painless one, that the palliative treatment of each case will depend on the peculiarities presented. Rest and support are of the greatest importance, as is also the constitutional treatment, which is indicated in all cases of tuberculosis, wherever situated. This consists of an abundance of fresh air and sunshine, moderate exercise, plenty of fats in the food and cod-liver oil. Changes of climate and scene, on which so many authors have laid stress, are probably of no great importance.

If there is no mixed infection and no fistulæ present, iodoform and zinc injections are absolutely contraindicated, and really have no place in the treatment of this disease. They are uncertain, and while, in a few cases, they seem to have been followed by good results, the procedure is not rational.

The method of treatment advocated by Mauclaire in his recent paper has not as yet been tested in a sufficient number of cases to say whether or not it will have a place in the treatment of tuberculosis of the epididymis and testicle. It is certainly not radical, and does not seem to be rational if, as he says, the testicle will be nourished by blood-vessels from the tunica vaginalis, after ligation of the spermatic cord. He, however, has noted disappearance of the nodules in several of his cases, and in almost all of them a subsidence of the vesical symptoms, and healing of the lesions in the vesiculæ seminales and prostate.

Orchiectomy was in vogue for many years prior to 1895, and is still advocated by many able men, as Koenig, Kocher, Terrilon, Richet and Senn, though most of them are opposed to double castration except in very exceptional instances. It would be the operation of election, because of its ease of performance and the rapid healing of the parts which usually follows, were it not for the unnecessary mutilation, the influence on general metabolism, the mental effect, and for the fact that patients will not consent to it until the disease is very far advanced. As the glandular portion of the testis is practically never primarily involved, and very rarely seriously secondarily affected, there is no good surgical basis for its removal. The claim, which has always been made by the advocates of castration, that the operation is more radical than epididymectomy, is not proved by the results of opera-

tions, and it is for the purpose of controverting this idea that this paper has been prepared and these cases cited. In 38 cases reported by Badenheuer in which castration was performed for tuberculosis of the testicle there was recurrence of the disease in the other organ 28 times. Bazy, Routier and Mauclaire have noted the same recurrence in the other testicle in many cases. These statistics form the strongest argument against castration that can possibly be brought forward, because, as the disease so frequently develops on the other side, a double castration will be inevitable, if it be true, as these authors claim, that it is the only radical operation.

Another great objection to the performance of castration is the profound mental effect which is induced in many patients, not only where both organs have been removed, but sometimes by the removal of one. Pujol, in 2 cases of unilateral castration, observed melancholia following the operation, and Fualds, in 3 similar cases, noted the development later of grave mental symptoms. These mental changes may in part be due to psychical impression, or they may be ascribed to absence of the internal secretion of the testicle, but whatever their cause, the fact remains that they develop in a certain and rather large percentage of the cases. The secondary secretion and its importance to normal metabolism were considered in the physiology. Tillaux, in 1896, says: "I believe that the testicular substance has an important influence on the general health. The secretion is resorbed in part by the system and contributes to the vigor of the organism." Audebal also condemns castration for the same reason.

We do not consider that a surgeon is justified in removing a testicle for tuberculosis where the epididymis, or only a part of the testicle proper, is involved. Even when the seminal vesicles are diseased, it does not supply an additional indication for castration, nor is the effect on the vesical symptoms more rapid or more pronounced and permanent when castration is performed than when the epididymis alone is ablated. After orchiectomy, in many cases, there is a gradual and often ultimately complete subsidence of the sexual desire, which is not the case after epididymectomy.

Curettage and Drainage.—This is of no more effect in the treatment of tuberculosis of the testicle and epididy-

mis than it is in the knee-joint or other tissue. It is followed by prolonged suppuration, further extension of the disease and final destruction of the organ. It has many disadvantages, and no advantages over the more radical epididymectomy. Where the testicle is much swollen and infiltrated, so that it is impossible to determine the exact condition of affairs, it is justifiable to incise and drain the infiltrated tissues, and later, after the acute infection has subsided and the exact extent of the disease ascertained, do an epididymectomy. Longuet advocates, in cases where the tubercular foci are softened and liquefied, incision into the abscess cavities, curettage of their walls and cauterization with the thermocautery or chlorid of zinc. His results in some cases were excellent. After curettage the wound may be packed with iodoform gauze and allowed to granulate, or it may be closed with sutures.

Excision of foci in the testical proper was advocated by Deville in 1852, and about the same time by Syme and Malgaigne (quoted by Longuet). Reclus has performed the same operation with perfect success. S. Duplay, in 1897, recommended dissecting out tubercular foci in the testicle and closing the defect left by suturing with catgut.

Epididymectomy.—L. Longuet, in his recent excellent paper, treated very extensively the subject of conservative operations for tuberculosis of the testicle, both from the historical and technical points of view. The first epididymectomy on record was performed by Jarjavay in 1850, upon a patient 20 years of age, with tuberculosis of the right epididymis. He resected the epididymis Aug. 7, 1850, and swabbed the wound out with tincture of iodin. As mentioned before, Syme and Malgaigne, for some time previous to Jarjavay's operation, had been teaching that in fungus and carcinomatous testicular affections not involving the whole organ the diseased portion only should be removed, and Deville, in 1852, saved a testicle which was prolapsed through an ulcerating scrotum by resecting the diseased foci. In these earlier operations, however, it was not the epididymis that was removed, but rather portions of the testicle proper in which the disease had become localized.

Typical total epididymectomy was probably first performed by Bardenheuer in 1880, and in 1887 he reported 12 successful cases. Tuffier in 1883, Villeneuve in 1889,

Duplay in 1890, Humbert in 1891 and Lejars in 1893, reported cases and advocated the conservative operations. Dr. Herman Mynter, of New York, in 1893, reported 2 cases in which he had performed epididymectomy one and two years previously. Both patients had remained perfectly well up to the time of the report, and there was no prospect of recurrence in either. Guyon, 1892, condemned castration where the epididymis only was involved. Longuet, during the period from 1895 to 1898, had performed 30 typical and atypical epididymectomies with most excellent results. Humbert, in 1897, published the reports of 15 resections, with good results in the majority of cases. Reclus has done a number of successful resections, but thinks the operation indicated only when the disease is distinctly localized in the epididymis.

Indications for the Operation.—Epididymectomy should be the operation of election in every case of tuberculosis of the epididymis, single or double, except under the following conditions:

1. Where there are extensive tubercular lesions elsewhere, which will shortly terminate the patient's life.

2. Where the disease has extended to and destroyed the greater part or all of the testis proper. Here castration should be done.

3. Where the scrotum is riddled with discharging sinuses. The indication is usually here also for castration. In every other case a resection, typical or atypical, should be done for the following reasons:

1. Because it is radical and removes all the diseased tissue.

2. It does not remove the healthy glandular portion of the testicle, the internal secretion being thus preserved.

3. Patients will consent to an early removal of the epididymis, thereby avoiding the disastrous results of further infection of the genito-urinary tract.

4. It has the same beneficial effect on the vesical symptoms as has orchiectomy.

5. Sexual desire and potency, even to emissions, are retained; power of procreation, however, is lost.

6. It has no ill effects on the general metabolism, nor does the patient suffer from the mental distress and melancholia mentioned above.

7. It is easy of performance and entirely devoid of danger.

8. The period of convalescence is short, and the good results are permanent.

The principal objections which have been brought against the operation are:

1. That it is not radical, as the rete testis is involved in every case, even where it appears normal macroscopically. (Koenig, Fink, Dürr.)

2. That atrophy of the testicle follows the operation.

3. That, as the patient will be sterile after either epididymectomy or orchiectomy, it is unwise to risk the possibility of leaving in infected tissue.

With regard to the first objection, e. g., that the operation is not radical, we have only to say that while theoretically this may be true, practically it is not. Where the rete testis is seriously involved, to such an extent that it will give rise to trouble later, it will always be possible to determine it macroscopically at the time of the operation, and excise the affected portion with the epididymis. If this is done, recurrence need not be feared, but even supposing it does take place in a small proportion of the cases, a localized focus in the rete can be excised at a subsequent operation and no harm result from the delay, for the reason that as the vas is absent, extension upward can not take place. As a precautionary measure, in order to avoid leaving infected tissue, some operators—Lejars, Koenig, Poncet, Delbet and André—have recommended an exploratory incision into the testicle, the subsequent operation, castration or epididymectomy, to be determined by the condition of affairs in the rete. In the cases which have come under our care, this has never been necessary, it always being possible to detect deposits in the rete at the time of removal of the epididymis.

The symptoms of vesical irritation subside, after resection of the epididymis, just as promptly and completely as after castration, and the healing of secondary deposits in the prostate and seminal vesicles takes place just as rapidly. Even where the tubercular process in these latter situations is far advanced, arrest, by cicatrization and encapsulation, is the rule after epididymectomy. For this reason it is never necessary to remove these organs.

The second objection, that atrophy of the testicle fol-

lows removal of the epididymis, is not founded on fact, for numerous observations and experiments have shown conclusively that when the operation is correctly performed and the spermatic vessels not interfered with, atrophy does not take place. (T. Dimetresco.) The testes not only retain their normal size, but also their natural firmness and sensitiveness. (Longuet.) Mauclaire, in one case upon which unilateral epididymectomy had been performed observed that the testis on the side of operation retained its normal size, while the opposite one became hypertrophied. In Cases 4 and 5 of our series the testicle presented some atrophy, which must be accounted for by a slight injury to the vessels at the time of operation; a considerable portion of the organ, however, remains in each case.

The third objection is hardly worth considering, as the importance of the internal secretion is not recognized by those who make it. After epididymectomy the patient is sterile, but not impotent, while after castration he is both. Reynier objects to the conservative operations because he thinks that permanent sinuses are often left. This is certainly not true if the operation is properly done. The sinuses which are occasionally formed quickly close.

The operation of epididymectomy is extremely simple and easy of performance, if the operator will first take the trouble to experiment on the cadaver. It amounts simply to an anatomical dissection, very little cutting being necessary, except in dividing the vasa efferentia where they enter the globus major.

The steps of the operation illustrated by Figs. 11, 12 and 13 are as follows:

1. Incision into the sac of the tunica vaginalis, just external and parallel to the epididymis.

2. Dissection of epididymis from testis proper, commencing below at globus minor and passing upward to mediastinum testis. From here one must proceed slowly and carefully so as not to injure the spermatic artery and veins, closely hugging the epididymis and separating it from the testis proper and spermatic vessels. Blunt dissection should be used when possible, cutting only when necessary. If a focus is discovered in the mediastinum it is to be excised in a wedge-shaped piece and the defect closed with catgut sutures.

3. When the globus major is free, the vas is to be iso-

lated from the other structures of the cord upward, as far as the internal ring, where it is to be clasped on both sides of its circumference with hemostatic forceps, divided and the lumen of the proximal end cauterized with 95 per cent. carbolic acid in the end of a needle. The needle is to be worked upward in the lumen for one-half inch and the mucous membrane thoroughly cauterized.

4. When cauterization is complete the vas is ligated with chromicized catgut, one-quarter of an inch from its end, so as to prevent infectious material from passing backward through it into the tissues. This step is considered of great importance as previous to the use of the ligature it was not uncommon to have induration and occasionally suppuration develop near the stump of the vas. The tunica albuginea is to be sutured with catgut, if it has been opened.

5. The testicle is now replaced in the scrotal sac, and the external wound closed either with a buried subcutaneous suture of catgut, or interrupted sutures of silkworm gut, leaving a small iodoform gauze drain in the lower angle for forty-eight hours.

6. After forty-eight hours the gauze drain is removed and provisional sutures, put in at the time of the operation, are tied.

REPORT OF CASES.

Case 1.—Mr. E. J. B., aged 22 years. Occupation, factoryman. Unmarried. Admitted to Alexian Brothers Hospital, Sept. 9, 1894.

Present Illness.—Six months ago patient first noticed some "chafing of skin" on the left side of scrotum, and a varicocele on the same side, which had been present for several months, became larger and somewhat painful. Shortly afterward a small papule developed on the irritated skin and this was opened by patient. Cheesy material was discharged, and a small sinus, which would not close, was formed. There was at no time any marked swelling of testicle and patient suffered but little pain. Has had no urinary symptoms of any kind. Has lost considerably in weight (10 pounds). No cough.

Previous History.—Chorea several times in childhood. Before onset of present trouble patient worked in a shop where much heavy lifting was a part of his daily labor. No history of venereal infection. No direct injury to testicles.

Family History.—No tuberculosis in any members.

Examination of Patient.—Medium stature. Nourishment

fair. Heart, lungs and abdomen negative. *Genitalia.*—Left epididymis thickened, hard, nodular and slightly tender to compression. Testicle proper, normal. A small sinus leading down into nodular epididymis is present in left side of scrotum. Right testicle and epididymis normal.

Operation.—Sept. 10, 1894. Operator, Dr. J. B. Murphy, assisted by Dr. E. H. Lee. Incision into left tunica vaginalis and dissection of epididymis from testicle proper, leaving the spermatic vessels undisturbed. Vas severed from other structures of cord, ligated and amputated at internal ring. Testicle proper replaced in sac of tunica vaginalis and skin wound closed with silkworm gut suture, leaving small gauze drain in lower angle. The night after operation some secondary hemorrhage took place and house surgeon applied a ligature to the bleeding vessel. After this the wound healed without further trouble, except at the upper angle, where a small sinus persisted. Sinus remained open for two years, when ligature was discharged and it closed. General health improved much after operation and he regained the flesh which he had lost. For ultimate results see notes under Case 5.

Case 2.—Mr. M. Z., aged 22 years; occupation, watchmaker; unmarried. Admitted to Mercy Hospital December 14, 1895.

Present Illness: For four years previous to last April, when the organ was removed, patient had had repeated attacks of pain and swelling in the right testicle. Eight weeks ago the left testicle began to swell and a permanent nodular enlargement developed. This has been accompanied by considerable dull, aching pain, and some tenderness in the mass. Urination has been frequent and painful. Family history negative as regards tuberculosis.

Examination of Patient: Right testicle absent. In the left side of the scrotum is a firm nodular mass situated posteriorly, and having in front of it the testicle proper, which is apparently normal.

Operation, Dec. 16, 1895; Operator, Dr. J. B. Murphy, assisted by Dr. E. H. Lee. Incision into left tunica vaginalis; dissection of nodular epididymis from the testicle proper; ligation and amputation of the vas high up, and cauterization of its lumen with 95 per cent. carbolic acid. Testicle replaced in the scrotum and the wound closed with silkworm gut sutures, a gauze drain being left in the lower angle. Cavity of the tunica vaginalis on the right side opened and a hollow oval ball of silver, the size and shape of a normal testicle, introduced and the wound closed. Convalescence was uneventful, and patient was discharged cured Dec. 25, 1895. In a letter received from him May 8, 1900, the following particulars as to his present state of health are given: His general health is excellent. He has gained ten pounds since the operation, now

weighing 180. He has no vesical irritation, and has passed no blood or pus in the urine. There has been no return of the disease since the operation, though patient states that occasionally he has some slight pain in the testicle, which may be attributed to the silver ball in the right side. There has been no atrophy of the left testicle proper. He has had no cough, fever or sweats. He has been married for several months and states that the sexual desire is normal, there being some discharge during intercourse. No nocturnal emissions since operation.

Case 3.—M. S. R. V., aged 30 years; married; occupation, electroplater. Admitted to Cook County Hospital, service of Dr. F. S. Hartman, Dec. 16, 1895.

Present Illness: About nine years ago right testicle was swollen for several weeks. Swelling gradually subsided, leaving a small, hard, painful nodule in the lower and posterior portion of organ, which has persisted until the present time. Frequent urination has been complained of lately, and he has had to void his urine every fifteen or twenty minutes without, however, having any pain during its passage. During the past two or three weeks he has had numerous hemorrhages from urethra.

Previous History: Patient claims he was never sick before, and positively denies any venereal infection. Family history entirely negative as regards tuberculosis.

Examination of Patient: Well-nourished man; heart, lungs and abdomen negative. Right testicle is enlarged, and a firm nodular mass can be felt involving the lower and posterior portion of the organ. In the left testicle there is a hard nodule occupying the upper and posterior portion.

Uranalysis: Dark color, neutral reaction. Specific gravity 1018. Albumin; no sugar. Microscopic examination, red blood-cells and pus in moderate amount.

Operation, Dec. 17, 1895. Operator, Dr. J. B. Murphy, assisted by Drs. Besley and Champlin. Incision over nodular mass in upper and posterior part of left testicle; diseased tissue well exposed, caught with forceps, and dissected from body of the testicle, the latter being apparently normal. Iodoform gauze drain inserted and the wound closed with silkworm gut sutures. Exactly similar operation performed on right side. Convalescence was uneventful and patient was discharged cured Dec. 31, 1895.

Examination of patient June 27, 1896, showed that there had been no return of the testicular disease, and the blood had disappeared from the urine. He had gained fourteen pounds since the operation, and sexual desire was same as before. About one year after operation, patient suddenly developed urinary suppression, which continued for twenty-four hours. Several days later he had a similar attack lasting

sixty hours. At this time the left kidney became enlarged and soon afterward, the right. He died of the renal complication, probably tuberculosis of both kidneys, early in February, 1897. There was no recurrence of the trouble in the testicles, and the lungs were unaffected throughout. Tubercle bacilli were found in the urine toward the close of the disease. While the ultimate result in this case was bad, the success of the operation, as regards the disease in the testicles and the relief of bladder symptoms, was demonstrated, as there was no sign of local recurrence, and no return of urethral hemorrhages up to the time of his death.

Case 4.—Mr. A. D. B., aged 38 years; occupation, driver. Admitted to Alexian Brothers' Hospital May 6, 1896. Present illness dates from three and a half or four years ago, at which time patient had what he calls "eczema of the scrotum." About two years ago urination began to be more frequent than normal, and he suffered from some burning pain at the base of the bladder toward the end of micturition. A short time after this he passed some blood and pus from the urethra. One year ago a perineal cystotomy was performed, and at the same time some operation on the testicles, the nature of which is unknown to the patient. After operation the urinary fistula remained open for three or four months, when it closed completely. Since closure of fistula he has been unable to hold his urine more than one and one-half hours, involuntary passage taking place after this time. He says that at the time of operation right testicle was discharging pus, but that soon after it the sinus closed. For the past one and one-half years left testicle has been gradually increasing in size, and has been the seat of considerable pain. At the present time he is obliged to urinate every hour at least. He often has pain at the base of the bladder and along the urethra. Several weeks ago a small ulcer developed on the glans penis, followed after about two weeks by a similar one on the prepuce. These are still present. The general health is good. Bowels constipated. Patient says he was never sick before. Family history negative as regards tuberculosis.

Examination of Patient: Both epididymi nodular and hard. Testicles proper show no signs of involvement. The inguinal glands on both sides very slightly enlarged. The prepuce presents on its inner surface a large shallow ulceration, which extends a short distance over the glans penis. Temperature on admission ranged from normal to 100.3 F.

Uranalysis on Admission: Straw-colored, cloudy, acid reaction, specific gravity 1018, albumin present in considerable quantities, no sugar. Microscopic examination showed pus cells, red blood-cells, a few granular and epithelial casts.

Operation, May 8, 1896. Patient circumcised for removal of preputial ulcer. Operation May 15, 1896. Operator, Dr.

J. B. Murphy, assisted by Dr. Oswald. Incision into cavity of right tunica vaginalis, testicle and epididymis well exposed, and the latter dissected from the former, beginning below and passing upward. Vas was amputated high up and lumen cauterized. Testicle proper replaced in sac, and external wound closed by means of silkworm sutures, leaving a small gauze drain in lower angle. Similar operation performed on the left side. Examination of epididymi showed both to contain typical caseous nodules. Patient was discharged from hospital June 4, 1896, the incision on the left side having closed by primary union. On the right side there was a small sinus at the lower angle of the wound, which was discharging a slight amount of purulent material. Uranalysis June 1 showed the same findings as on admission, except that the urine was clearer and contained less blood and pus. On the day of discharge from hospital a few pleuritic friction sounds were heard in the right side of the chest.

Examination of patient July 11, 1900: General health excellent; patient now weighs 150 pounds, which is more than he ever weighed before. Has no cough; appetite good; no symptoms referable to the genital organs, except some itching of the scrotum. Vesical irritation, which was such a marked symptom before the operation, disappeared almost entirely within a month or six weeks after it was performed, and has never returned in anything like the same degree. Occasionally he is obliged to urinate more frequently than normal, and usually has to get up two or three times during the night. Has no pain during urination and never passes blood. Sexual desire is the same as before onset of trouble, and the sensation attending intercourse is also the same, though he has no discharge of seminal fluid. It was neglected in the history to mention that for about one and a half years before the first operation there had been no seminal discharge during coitus.

Examination of the heart, lungs and abdomen negative. Genitalia: The right testicle proper is of normal size and consistency, and there is absolutely no sign of recurrence of the disease. The left testicle is very much atrophied, not being larger than the end of the middle finger. It is hard, but not at all tender, and there is no evidence of any recurrence of the tubercular trouble. Rectal examination shows the prostate and seminal vesicles to be free from disease.

Uranalysis July 11, 1900. Clear, yellow, acid reaction, no albumin, no sugar. Microscope showed no pus, blood or casts.

CASE 5.—(See Case 1). Mr. E. J. B., aged 24 years. Occupation, factoryman. Unmarried. Admitted to Alexian Brothers' Hospital Aug. 17, 1896.

Present Illness.—Left epididymis was removed for tubercular disease Sept. 10, 1894. Small sinus persisted in wound after operation and closed only a short time ago. Health has

been good until about one month ago, when the right testicle suddenly became enlarged, tender and painful. He has lost some flesh, but has had no cough, fever or sweats. No urinary symptoms have been present, either during this or the previous attack. Previous and family histories given under Case 1.

Examination.—Man of medium stature. Nourishment fair. Heart, lungs and abdomen, negative.

Genitalia.—Cicatrix of former operation present on left side of scrotum. No recurrence of disease here, and testicle is of normal size and consistency. Right side of scrotum swollen. Right epididymis enlarged, hard, nodular, and very tender. Testicle proper not involved, so far as examination shows.

Operation.—Aug. 18, 1896. Operator, Dr. J. B. Murphy. Assistant, Dr. E. H. Lee. Epididymectomy performed—exactly similar to that done on left side. Drain removed after 36 hours. Wound healed by primary union and patient was discharged from hospital cured Sept. 1, 1896.

Examination of patient, April 7, 1900. Has gained thirty pounds since operation. Feels perfectly well. Has no cough, fever or sweats. No urinary symptoms. Sexual desire and sensation are the same as before onset of trouble, and patient says that seminal discharge is of the same quantity. Patient always supports testicles in a suspensory. If suspensory is not used, left testicle swells and becomes tender. No pain or tenderness when supported.

Examination: Both testicles present in scrotum and of normal consistency. No nodules present in either. Above left testis is a small firm band about three-quarters of an inch in length, not nodular, but slightly tender to compression. No hydrocele. Patient says the testicles are somewhat smaller than before operation, and they apparently are slightly atrophied. Rectal examination shows in each seminal vesicle a small, very hard and painless nodule. The tubercular process has here been arrested and encapsulated. Discharge during intercourse, clear, looks like mucus; no spermatozoa.

Case 6.—Mr. G. L., aged 37 years; occupation, carpenter. Admitted to Alexian Brothers' Hospital Sept. 21, 1897.

Present Illness: About one year ago patient began to cough and lose flesh. Since then he has coughed continuously, expectoration being at times quite profuse, and occasionally bloody. Loss of flesh has been marked. For some time past he has had afternoon fever, night sweats, loss of appetite and diarrhea. Three years ago he developed an empyema, which was opened and drained by Dr. Murphy. The empyema sinus is still discharging pus. Four months ago patient noticed a small nodule in the right testicle at its posterior and lower portion. This has gradually increased in size, but has caused no pain or other symptoms referable to it. Complains of increased frequency of urination.

Previous History: No points of interest except those given above.

Examination of patient shows physical signs of the conditions recorded in the history. The nodule in the globus minor is about the size of a hickory-nut. The testicle proper is apparently not involved.

Operation Sept. 23, 1897. Operator, Dr. J. B. Murphy, assisted by Dr. Moran. Incision through the scrotal coverings down to the epididymis. Epididymis picked up with forceps and dissected from testicle proper, beginning below and passing upward, the spermatic vessels being left intact. Cord ligated high up and its lumen cauterized with 95 per cent. carbolic acid. External wound closed after first replacing testicle in scrotum. Small gauze drain left in lower angle of wound for twenty-four hours. Convalescence after operation was uneventful, and patient was discharged from the hospital cured, so far as his testicular trouble was concerned, Nov. 15, 1897.

This patient later developed a tuberculosis of the spine, and died from a general miliary infection some months after the operation. No recurrence of symptoms referable to the genito-urinary organs.

Case 7.—Mr. W. C.; nativity, Ireland. Age, 38 years; married; occupation, laborer. Admitted to Cook County Hospital Oct. 6, 1897.

Present Illness: About seven months ago patient first noticed swelling in the left side of the scrotum, which swelling had appeared quite suddenly and attained a somewhat larger size than at present in the course of a few days. Its appearance was accompanied by sharp, shooting pains. The swelling remained stationary for five or six weeks, when it partially subsided. The pains decreased with the reduction in size of the testicle. About five weeks before admission to hospital a similar swelling developed in the right side of the scrotum, this running a course resembling the above. He now complains of some pain in the right testicle.

Previous History: Denies syphilis and gonorrhea. Has two children, oldest 18 and youngest 2 years of age. Family history entirely negative as regards tuberculosis.

Examination: General nourishment good. Scrotum presents on the right side an ovoid mass, about 3 by 6 cm. in size, situated posterior to the body of the testicle, which is apparently uninvolved. This ovoid mass is composed of several hard nodules. The spermatic cord is negative. On the left side the epididymis answers to the same description as on the right, but here the tunica vaginalis is distended with fluid. Rectal examination shows the prostate and vesiculæ seminales to be normal. Left spermatic cord normal.

Operation Oct. 29, 1897. Operator, Dr. J. B. Murphy, assisted by Drs. Simpson and Morf. Incision into scrotal sac on each side down to the tunica vaginalis. Hydrocele on right side evacuated. Epididymis on both sides now removed by dissecting each from its testicle proper, carefully avoiding the spermatic arteries and veins. Testes replaced in scrotum, hemorrhage controlled and external wound closed with silkworm gut sutures; gauze drainage in each lower angle. Patient was discharged cured Nov. 12, 1897.

Unfortunately we have been unable to locate the patient since his discharge from the hospital, so can not report as to final outcome of the operation.

Case 8.—Mr. W. L. M., aged 35 years; occupation, clerk. Admitted to Mercy Hospital, July 18, 1898.

Present illness began about one month ago with sudden painful swelling of the right testicle, the pain being quite severe and aggravated by patient being on his feet. He has had almost constant headache since the onset. Appetite is good; has no night sweats or fever. Since onset of trouble he has lost considerably in weight; bowels are constipated. Patient complains of frequent urination, it being necessary for him to get up several times every night to void urine.

Previous History: At the age of 13 years he had enlarged cervical glands, which disappeared under treatment. He has also had "scarlet fever" and "cystitis." No specific history.

Family History: One aunt died of miliary tuberculosis.

Examination of patient negative, except as regards sexual glands. On posterior surface of the right testicle there is a hard nodular mass, slightly tender to pressure. The testicle proper is apparently normal. A small amount of fluid is present in the cavity of the tunica vaginalis; cord not involved.

Uranalysis on Admission: Quantity in twenty-four hours, 1200 c.c.; specific gravity, 1011; reaction, acid; color, yellow, cloudy. No albumin, no sugar. Microscopic examination, small amount of pus, no casts.

Operation, June 20, 1898. Operator, Dr. J. B. Murphy, assisted by Drs. Bick and Daly. Incision on right side of scrotum down to epididymis and into sac of tunica vaginalis. This incision was extended upward to the external inguinal ring. The nodular epididymis was dissected from the testicle proper, beginning below and passing upward, leaving the testicle and spermatic vessels intact. The vas was ligated and amputated high up, and the lumen of the stump cauterized with a red-hot needle. A few catgut sutures were introduced into the tunica albuginea to check oozing, and the testicle proper then replaced in the scrotum. The fascia was sutured over the cord with buried catgut and the skin wound closed by means of a subcutaneous suture of fine catgut. Collodion dressing.

The patient made a perfect recovery and was discharged cured Aug. 6, 1898. Urinalysis on the day of discharge from hospital showed the following: Slightly cloudy; reaction, acid; specific gravity, 1012; no albumin; no sugar. Microscopic examination, very small amount of pus.

(For ultimate result see under Case No. 9.)

Case 9.—Mr. W. L. M., aged 35 years. (See Case No. 8.) Admitted to Mercy Hospital Sept. 30, 1898.

Present Illness: Last July, about two months ago, patient underwent an operation for the removal of the right epididymis. Shortly after operation left testicle became swollen, slightly tender and painful, and this condition has persisted, gradually becoming more severe, until the present time. He still complains of frequent urination.

Examination shows nodular swelling of the left epididymis, adherent to the surrounding structures, very hard and slightly tender to compression. There is no sign of recurrence of trouble on the right side. Chest and abdomen negative.

Uranalysis, Oct. 1, 1898, yellow, slightly cloudy, reaction acid, specific gravity 1015, no albumin, no sugar. Microscopic examination, small quantity of pus; no casts.

Operation Oct. 1, 1898. Operator, Dr. J. B. Murphy, assisted by Drs. Rogers, Baccus and Daly. Incision one and a half inches long parallel to raphe, near the bottom of the scrotum; small amount of fluid escaped. Testicle drawn out and epididymis dissected off, leaving the vessels passing to the testicle proper intact; vas ligated, amputated and lumen cauterized. Testicle returned to scrotum and skin wound closed by means of a buried suture of silkworm gut. Small iodoform gauze drain left in lower angle of wound. Uneventful convalescence after operation. Patient discharged as cured Oct. 15, 1898.

Uranalysis, Oct. 3, 1898, quantity in twenty-four hours, 1250 c.c., pale yellow, slightly turbid, reaction neutral; specific gravity, 1012; no albumin, no sugar.

Microscopic examination: Numbers of epithelial cells and a very few pus cells.

Examination of patient Nov. 9, 1899. General health excellent. No recurrence of tubercular trouble in either testicle, both being apparently normal. No atrophy has taken place. Patient now has no vesical irritation.

Examination March 25, 1900. Patient feels perfectly well; has gained fifteen pounds since last operation, now weighing 145. The sexual desire is the same as before the onset of the disease, and the sensation attending intercourse is unchanged. The seminal emission is less than normal, and patient now has no nocturnal emissions. The vesical irritation has entirely disappeared.

Case 10.—Mr. S. R. A., aged 47 years; married. Admitted to Mercy Hospital Sept. 30, 1898.

Present Illness: Several months ago patient first noticed a small nodule, slightly painful and tender to pressure, on palmar aspect of right index finger. This steadily enlarged and some swelling developed along the entire length of the finger, extending into the palm. Several weeks after swelling was first noticed patient received a slight traumatism to the left testicle. Almost immediately afterward testicle became swollen and the epididymis gradually developed the hard nodular condition which is now present. Testicle is only slightly painful and tender under compression. Patient complains of some increased frequency in urination, and the urine is cloudy. He has no cough and the general health is good. No tuberculosis in family.

Examination of the Patient: Large stature; well nourished; heart, lungs and abdomen are negative. Index finger of right hand swollen along its entire palmar aspect, the swelling extending into the palm. It is only slightly tender to pressure, the skin over it is not reddened, and along the course of the tendon several small nodules can be felt. Function is much impaired. Left epididymis is thickened, hard, nodular and adherent to the surrounding tissues. The spermatic cord is apparently not involved.

Uranalysis, Oct. 1, 1898. Quantity in twenty-four hours, 1200 c.c.; reaction acid, specific gravity, 1014; color, yellow; cloudy, trace of albumin, no sugar. A few granular casts and pus cells were found under the microscope.

Operation Oct. 1, 1898. Operator, Dr. J. B. Murphy, assisted by Drs. Rogers and Daly.

1. Finger. Esmarch on wrist. Incision on palmar surface of finger along its entire length down to tendon; numerous rice bodies escaped. Fungus granulations dissected out, hemorrhage controlled and wound closed with buried silkworm gut suture. Collodion dressing.

2. Testicle. Incision one and a half inches long near the bottom of the scrotum on the left side, into the cavity of the tunica vaginalis; small amount of hydrocele fluid escaped; testicle drawn out and diseased epididymis dissected from it, the dissection beginning below and proceeding upward. The spermatic artery and veins were left intact; the vas ligated and amputated high up and its lumen cauterized with 95 per cent. carbolic acid. One or two fine catgut sutures were used to draw together the edges of the abraded surface, left by the removal of the globus major. Testicle now returned into the scrotum and the wound closed by means of buried catgut suture, a small gauze drain being left in the lower angle of the wound.

Uninterrupted convalescence followed the operation, and patient was discharged cured Oct. 10, 1898.

(See Case No. 11 for result.)

Case 11.—Mr. S. R. A. (see Case No. 10), aged 49 years. Admitted to Mercy Hospital Feb. 13, 1900.

Present Illness: Since Oct. 1898, when patient underwent operation for the removal of the left epididymis, his health has been good. Five or six months ago some soreness developed in right epididymis, and a small hard nodule became palpable. There has been no pain in the testicle except on pressure. He complains of frequent urination, the act being accompanied by some pain at the base of the bladder. General health at present is good.

Family history and previous history given under Case No. 10.

Examination of the Patient: Nourishment good; lungs, heart and abdomen negative. Cicatrix on palmar aspect of index finger of right hand present; no recurrence of trouble here. Left epididymis absent, and the wound left by former epididymectomy now scarcely noticeable. No atrophy of left testicle and no sign of recurrence of tubercular trouble. The right epididymis is hard, nodular and slightly tender to pressure, the process being confined quite closely to the globus major. The vas is apparently uninvolved. The right seminal vesicle is slightly thickened, while the left is apparently normal.

Uranalysis Feb. 17, 1900. Color, light yellow, slightly cloudy; acid reaction; specific gravity, 1015; urea, 1.5; albumin, trace; no sugar.

Microscopic examination: A few hyaline and granular casts found. Pus cells numerous. Tubercle bacilli found in the centrifuged specimen.

Operation Feb. 14. 1900. Operator, Dr. J. B. Murphy, assisted by Drs. Lemke and Eggert. Incision two inches long into cavity of tunica vaginalis over nodular epididymis, just to the right of it. Testicle brought out of wound; tunica vaginalis incised at upper border of testes, and dissected from epididymis laterally. Epididymis now dissected from the testicle proper, leaving the nutrient vessels of the latter intact; vas clamped as high as possible, amputated and lumen cauterized with 95 per cent. carbolic acid. Abraded surface left by removal of the epididymis now covered by flaps of tunica vaginalis and testicle returned into the scrotum. Small gauze drain introduced into lower angle and the external wound closed with silkworm gut sutures. The day after the operation irritability of the bladder had almost entirely subsided, and has not since returned. Convalescence was uneventful, and patient left hospital March 3, 1900.

Several later examinations of the urine show a small amount of albumin to persist, with a few hyaline and granular casts. In the centrifuged specimen pus cells are still found, though in smaller numbers than before operation. Tubercle bacilli have also been demonstrated on several occasions since the last operation.

Examination of patient June 20, 1900: General health excellent; has gained fourteen pounds since the last operation; appetite is good. There are no signs of recurrence of the tubercular trouble in either testicle. Vesical irritability not now present, although occasionally he is obliged to urinate somewhat more frequently than normal. No pain on urination and no blood passed. Rectal examination shows in each seminal vesicle a small, very hard nodule, which is only slightly tender to pressure. The foci in the seminal vesicles have evidently become encapsulated, as there are now no tubercle bacilli present in the urine. We believe that the seminal vesicles were the source of the bacilli which persisted so long after the last operation.

CASE 12.—Mr. P. McC., aged 30 years; married; occupation moulder. Admitted to Alexian Brothers Hospital March 11, 1900.

Present Illness: Patient has a double hydrocele, each side being as large as a goose egg. Scrotum has gradually increased in size since November, 1899. Patient complains of pain in lumbar region and scrotum; also of great weakness.

Previous History: Diseases of childhood; specific urethritis five years ago. Initial lesion of syphilis ten years ago. Inguinal adenitis in 1894. Operation for hernia in 1899.

Family History: Negative as regards tuberculosis.

Examination of Patient: Heart and lungs negative; cicatrices of hernial operation in both inguinal regions.

Genitalia: Scrotum very much enlarged, due to double hydrocele. Testicles situated below and behind the fluid sacs. Both testicles are apparently somewhat enlarged, and epididymi enlarged and nodular, especially in the region of the globus major.

Uranalysis: The urine contains some pus, and the centrifuged specimen shows tubercle bacilli.

Operation March 12, 1900. Operator, Dr. J. B. Murphy, assisted by Drs. Lee and Hess. Two incisions, one on each side of the median line of scrotum. Hydroceles exposed, sacs opened and fluid evacuated. Testicles drawn out and inspected: both epididymi nodular and thickened, the tubercular deposits extending for a short distance on to the tunica albuginea of the testicle proper. Both hydrocele sacs dissected out and removed; both epididymi and adjacent tunica albuginea removed by dissecting from the testicle proper, beginning be-

low and passing upward, leaving the vessels of the testicle proper intact. Cords isolated, and the vas on each side clamped and ligated high up. Lumina cauterized with 95 per cent. carbolic acid. Cut edges of tunica albuginea approximated and sutured. A small gauze drain inserted at the lower angle of each scrotal incision and external wounds closed.

Microscopic examination of epididymi showed large amount of old fibrous connective tissue, with a few scattered tubercles containing giant cells.

Convalescence uneventful, and patient discharged from the hospital March 15, 1900.

We have been unable to trace this patient since his discharge from the hospital, so can not report on his present condition.

Case 13.—Mr. J. M., aged 37 years; German; married. Admitted to Alexian Brothers' Hospital, April 1, 1900.

Present illness dates from two months ago, when patient was taken sick with high fever, pains all over the body and other symptoms of an acute infectious disease. He had no cough or any localizing symptoms at first, but two days after the onset the left testicle suddenly became swollen, and he experienced some pain in the left inguinal region. Testicle continued to enlarge for a number of days, but was not tender, and was the seat of no pain. He did not complain of frequent urination, and never passed blood in the urine. The bowels have been constipated, and he has some pain in the rectum during defecation.

Previous History: Patient states that twelve years ago he "strained himself," and soon after had some swelling and pain in the right testicle. The symptoms subsided after a few days, but a nodule remained in the upper and posterior portion. This nodule enlarged slowly and two years ago a surgeon incised the swelling and allowed "water" to escape. No tissue was removed at that time, and the nodule is still present. One year ago patient suffered from very frequent and painful urinations, and on two occasions passed some blood in the urine. At that time he had fever, and during the six months that the trouble persisted lost twenty or twenty-five pounds in weight. He had no symptoms directly referable to the testicles at that time. After about six months the symptoms disappeared and he was in good health until the onset of the present trouble, two months ago. He denies absolutely ever having had any venereal disease. No history of injury. He is married and the father of a number of children.

Family history presents no points of interest. No tuberculosis in any of the members so far as can be ascertained.

Examination of Patient: Medium stature; nourishment poor; temperature, 98.6 F.

Heart and lungs negative. Abdomen, some slight diffuse tenderness. The edge of the liver is palpable three-quarters of an inch below the costal arch. Kidneys are not palpable. There is quite marked tenderness in the right lower quadrant of the abdomen.

Genitalia: In right epididymis there is a hard, round and slightly tender nodule in the globus major. The vas deferens passes somewhat more anteriorly than normal, and the testicle is rotated so that the epididymis lies to the inner side rather than posteriorly. In the left epididymis there are numerous hard nodules massed together. The cord is thickened and tender at its lower portion.

Rectal Examination: Both seminal vesicles are enlarged, the right soft, the left nodular and tender. Urine, yellow, turbid, reaction acid. Trace of albumin. The microscope reveals pus cells and a few red cells. No tubercle bacilli found.

Operation April 12, 1900. Operator, Dr. J. B. Murphy. Incision over the left epididymis and cord, epididymis dissected from testicle proper, leaving the spermatic vessels intact. The cord was dissected from the surrounding tissues up to the internal ring, where it was ligated, amputated, and the lumen cauterized with 95 per cent. carbolic acid. Testicle proper replaced in scrotum, and wound closed with subcutaneous suture, leaving a small gauze drain in the lower angle. Right epididymis not operated upon, as the process had evidently been arrested by encapsulation. Convalescence was uneventful, and the patient discharged about ten days after operation.

Since discharge from hospital, pain in the left groin has persisted. Left testicle is tender, as is also the stump of the amputated cord. Occasionally he is obliged to pass the urine oftener than normal, but has passed no blood. Complains of some pain in the left ilio-lumbar region, which is aggravated by stooping forward. Defecation is still painful. He states that his weight is the same as before operation. Has no chills, fever or sweats. Has some burning pain in the urethra during urination. There is a small discharging sinus in the cicatrix on the left side of the scrotum, and the tissues posterior to the testicle and at the stump of the cord present some inflammatory infiltration. Both seminal vesicles are in the same condition as they were when patient was admitted to the hospital. Heart, lungs and abdomen negative.

In a letter written August 25, 1900, patient states that he is at work and feeling better, but still has considerable pain in the left side and back. It was not possible for him to come to the city for examination.

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